MODERN REFRIGERATION

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Vol. 64 No. 758 MAY, 1961 Price 2s. 6d. monthly

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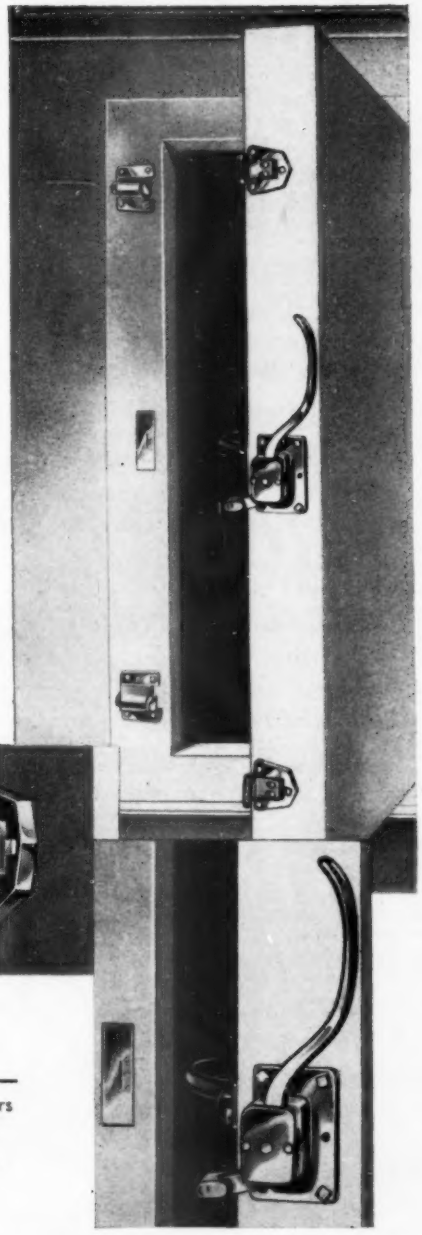

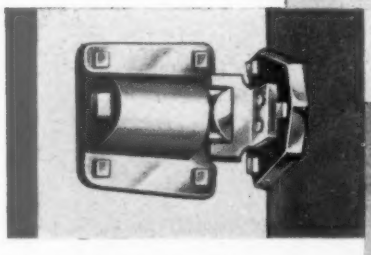

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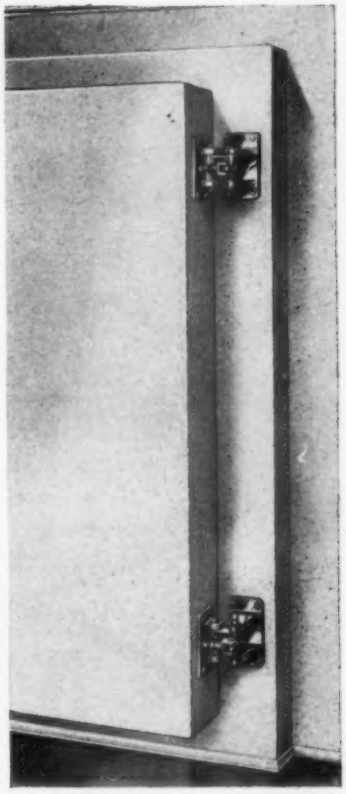

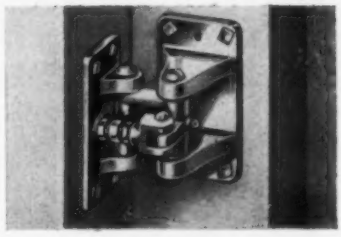

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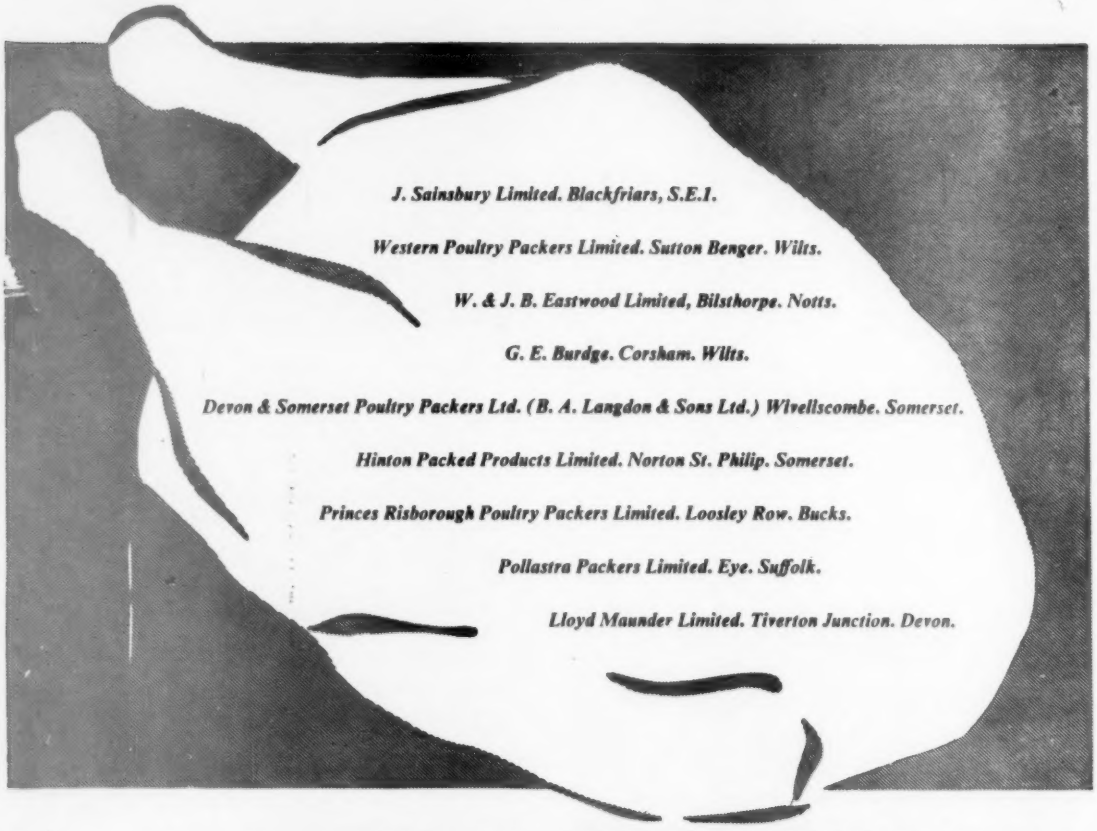

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It has been specially designed for its purpose and is arranged to fit readily
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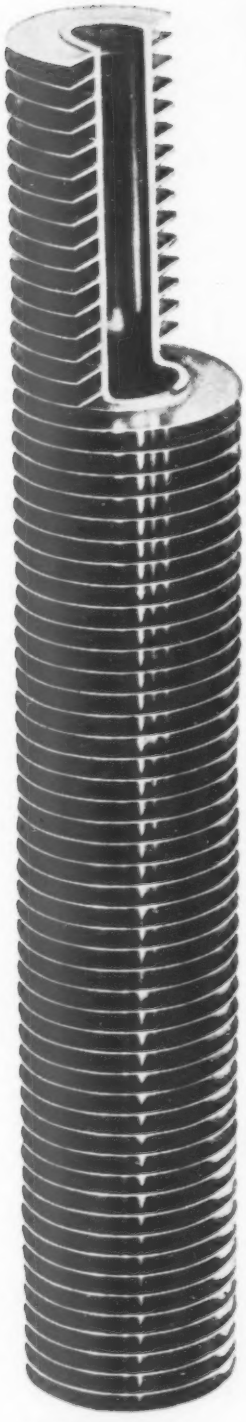

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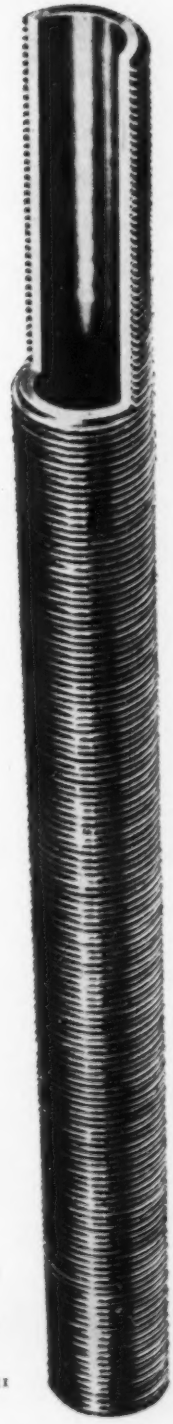
Integral finned tubing for ***maximum heat transfer efficiency***



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INT.11

THE CIVIL ENGINEERING ASPECT OF INSULATION

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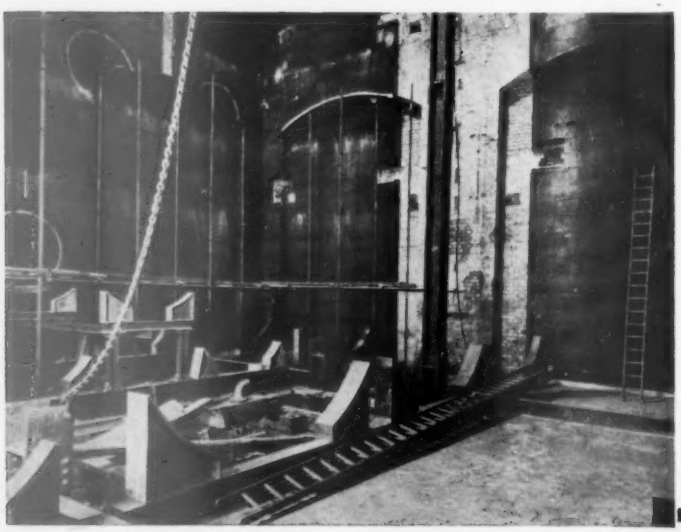
To carry out work of the character illustrated in the accompanying photographs requires more than the ordinary knowledge of insulation for temperatures lower than atmosphere. It requires definite knowledge of Civil Engineering methods, the employment of labour, Civil Engineering experience, and above all—wise direction.

A vertical tower for the housing of Beer Chilling Tanks in the refrigerated space, being carried out for Messrs. Charrington & Co. Ltd., Mile End, jointly with Messrs. J. & E. Hall Ltd.



control at long range can be pretty exciting. Somewhat mystifying too, when you're not quite sure how it works. Control has no mysteries, though, for Ranco. We're the experts, and the controls we make are the most reliable, most adaptable anywhere. Ranco thermostats and relays for fridges, domestic and commercial—everyone knows them. Ranco solenoid valves too . . . and reversing valves . . . and car heater controls. We also make a variety of motors for hermetically sealed refrigerator compressors. And we're constantly extending the Ranco range to meet the exacting demands of industry all the world over. Every Ranco control, remember, undergoes the most rigorous of tests—under actual working conditions—before we part with it.

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Tecumseh AM compressors save space without sacrificing efficiency. Their BTU per watt is high (up to 475:150 at 60 cycles) and they are as quiet as a mouse — or quieter!

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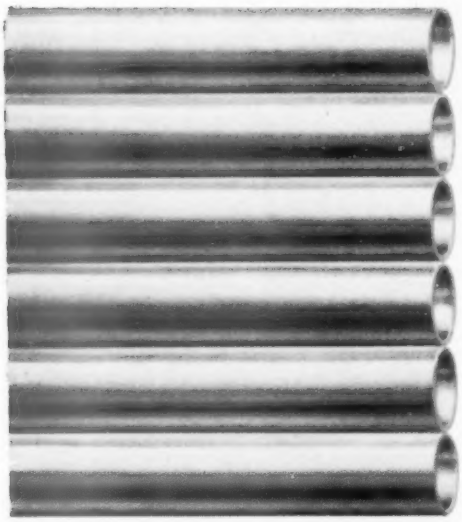

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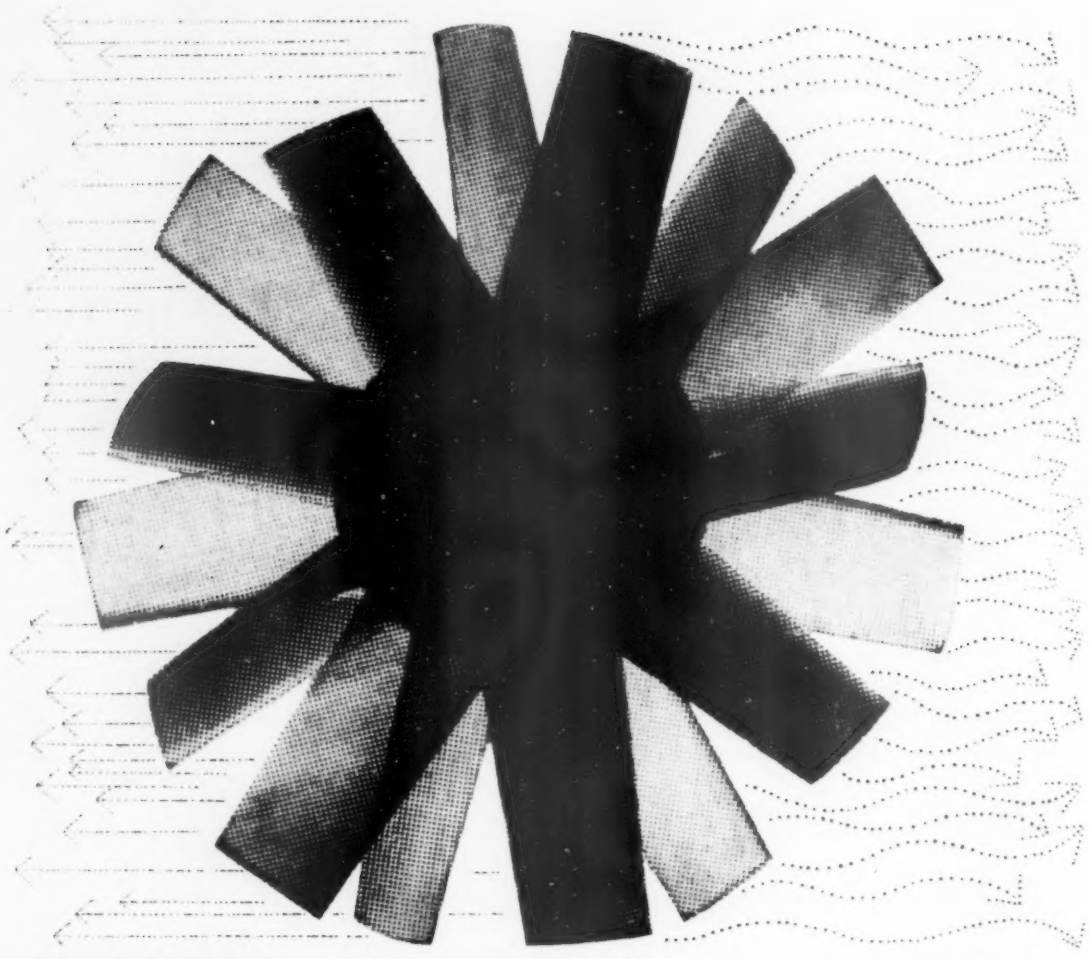

BLOW HOT, BLOW COLD Any number of heat transfer problems are being solved more simply with **IMPALCO** aluminium heat exchange materials. Three are particularly successful—'Tube-in-Strip' (which speaks for itself), Impalco Heat Transfer Sheets, which give you tubeways to your own design, and 'Integron' finned tubing. They have one thing in common—their integral construction. Between them, they provide the logical, efficient and economic way of transferring heat from one medium to another in condensing, evaporating, heating or cooling plant. Make life easier for yourself — write to us for details of these exceptionally useful and versatile materials.

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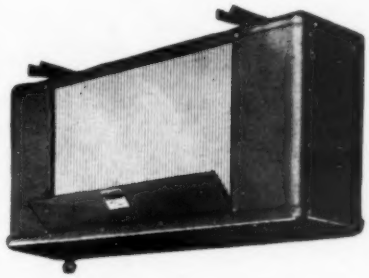

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Teddington

Type RD Thermostatic Expansion Valve

FOR FREON 12 AND FREON 22

- ✲ Self-contained—no capillary or phial
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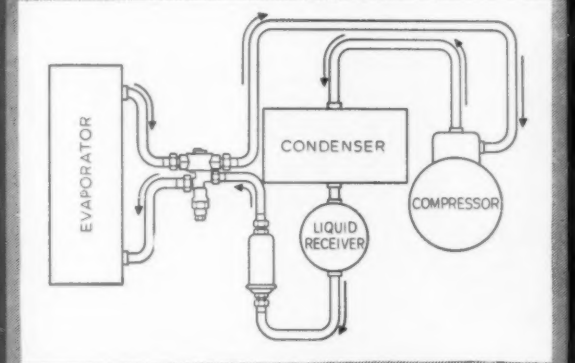

Typical Vapour Compression Refrigeration Circuit incorporating Teddington Type RD Expansion Valve

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AUTOMATIC Teddington CONTROLS

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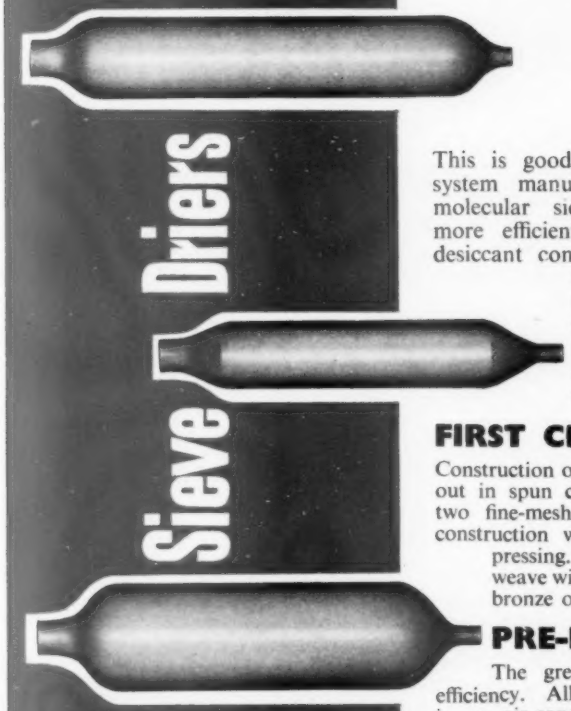
DAVID SCOTT
NEW Molecular Sieve DRIERS

LOW INITIAL COST *PLUS* 9 times greater efficiency than Standard Driers

The Sieve Driers that Save



This is good news for all sealed refrigeration system manufacturers. David Scott high side molecular sieve driers are now nine times more efficient than standard driers. With a desiccant consisting of a molecular sieve filled with type 4A 8 x 12 mesh beads, they have actually nine times the normal adsorption. Consider the economic advantage. With David Scott high side driers you save size and weight.

FIRST CLASS CONSTRUCTION

Construction of these remarkable new driers is carried out in spun copper shell with a desiccant between two fine-mesh strainers. Outlets screen is of bag construction with secure retention in a brass ring pressing. This is formed from a 150 mesh twill weave wire cloth or equivalent in either phosphor bronze or monel.

PRE-PURCHASE PROTECTED

The greatest care is taken to ensure 100% efficiency. All driers are manufactured and stored in an air-conditioned atmosphere.

EASY AND SAFE TRANSPORTATION

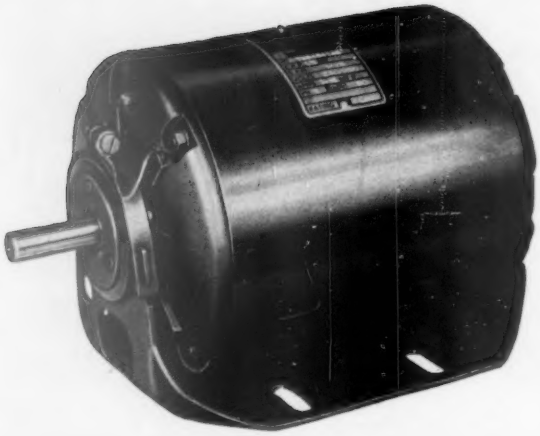
Though there is the minimum risk of moisture adsorption from the surrounding atmosphere, David Scott new high side driers can be individually sealed before leaving the factory. All driers are shipped in hermetically sealed canisters.

Inlet and outlet connections conform to manufacturers own requirements.

Other David Scott products include RECHARGEABLE DRIERS from ⅜″ o/d to 1⅜″ o/d pipe, and ACCUMULATOR DRIERS with copper shell squeezed and silver soldered at each end.

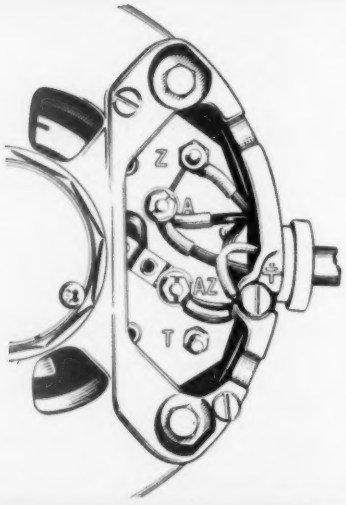
★ *A special feature of the David Scott service is the manufacture of driers to clients own specifications.*

David Scott
AND COMPANY LTD
KELVIN AVENUE HILLINGTON
GLASGOW S.W.2
TELEPHONE HALFWAY 4621



The design of a really first-class F.H.P. motor begins, you might say, where the design of larger motors ends. For F.H.P. motors are made in very large numbers and yet have to be quite exceptionally reliable (the reputation of other equipment may depend on them). They must be capable of being serviced anywhere and must be particularly simple to install. The means to achieve these things are not found in text books. They can be learned in only one way – detail by detail over many years of making F.H.P. motors. They are, in short, what is meant by . . .

This thing called know-how



Take the rear cover of one of our F.H.P. motors. It looks ordinary enough but it is in fact a remarkably successful piece of detail design. Within its small diameter, room has been found for a terminal box far larger than is usual on F.H.P. motors (which makes installation quicker), a very large oil reservoir for the bearing (which reduces maintenance) and large ventilation openings. Moreover, the cover has to be made at a competitive price. This kind of design comes of experience, and a great deal of unwritten knowledge is built into it.

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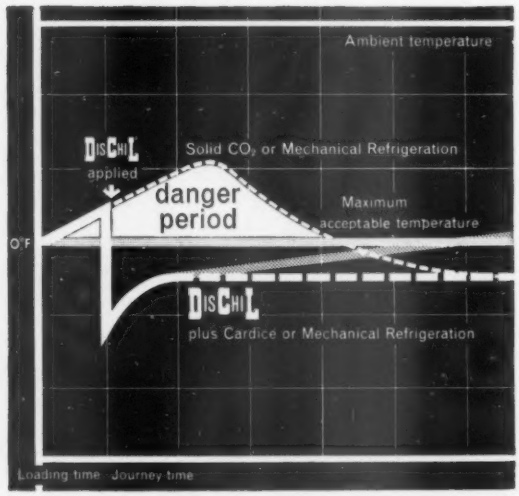
If you will write to us, we will be glad to explain the four ways in which you can get DisChiL service.



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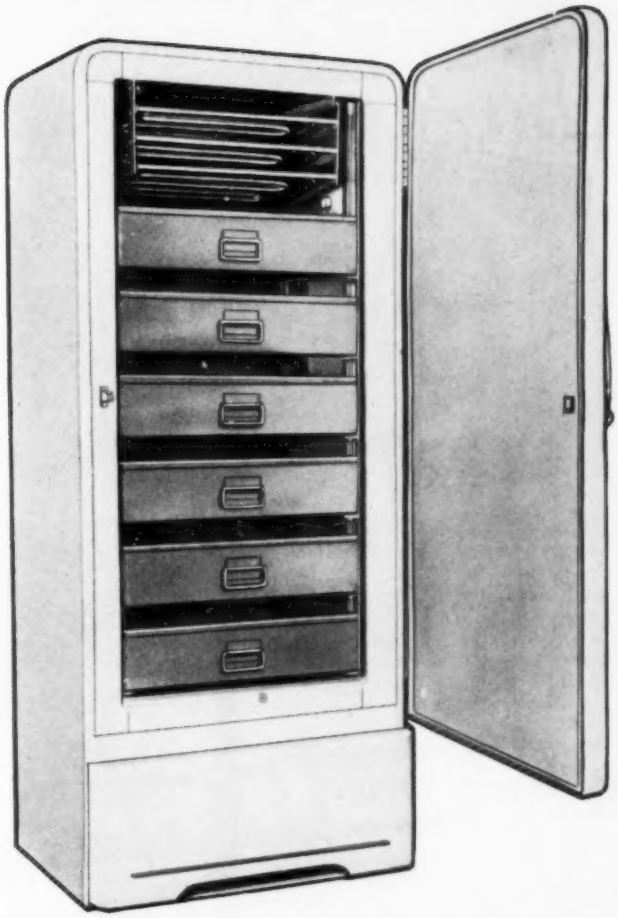

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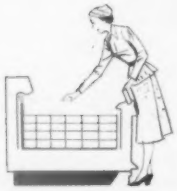

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* **Illustrated, Right to Left—one Frozen Food Case—two Fresh Meat Cases—two Special Bacon Cases—three Dairy Cases**

The ever increasing installations of Smithfrige-McCray cases in Supermarkets and Stores is evidence of their standing advantages. Smithfrige-McCray plus features—modern styling, new colour schemes, easy shopping angle, exclusive "Koldflo" cooling system open up new fields for Extra Sales, Extra Product Variety. Meat—Frozen Food—Dairy and Produce cases, in standard 8 ft. lengths. Full details and all possible assistance in preparing layouts readily available from

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combine to introduce an outstanding development in TRUCK REFRIGERATION EQUIPMENT

Behind the development of Stone-Carrier truck refrigeration equipment lies the vast experience of Stone's, specialists in electrical installations on wheeled vehicles, and that of Carrier, pioneers in air-conditioning and refrigeration. Stone-Carrier equipment has proved itself on trains over the past 25 years, and its success in trucks and other insulated road vehicles has been demonstrated under the most arduous operating conditions.

STONE - CARRIER

MAKE SURE IT'S
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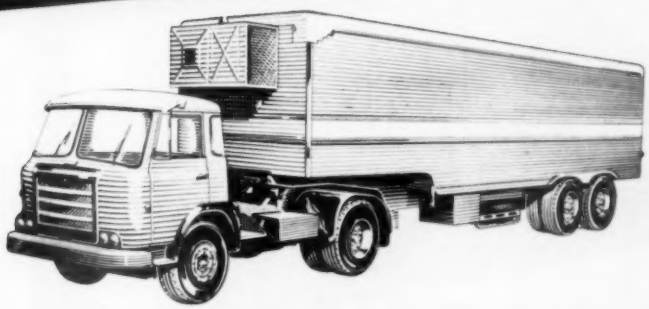

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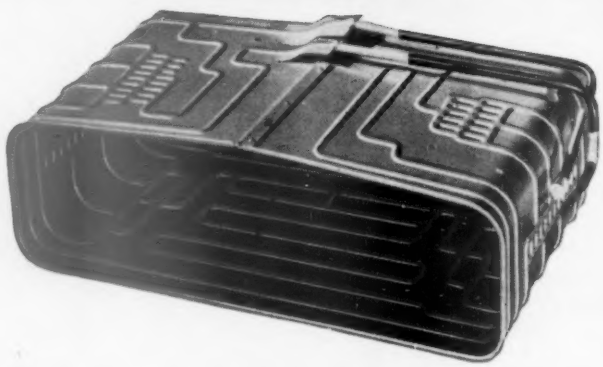
Light alloy roll-welded evaporator units offer many advantages: superior performance, light weight, attractive appearance, flexibility of design, competitive prices. A production line specially equipped for the fabrication of these units is operated by Marstons, specialists in heat transfer for sixty years. Why not discuss your design and production problems with them?



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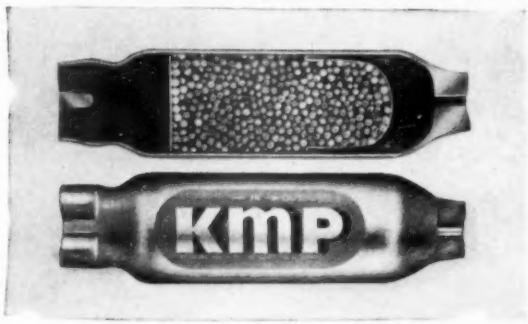
KENMORE DRIERS

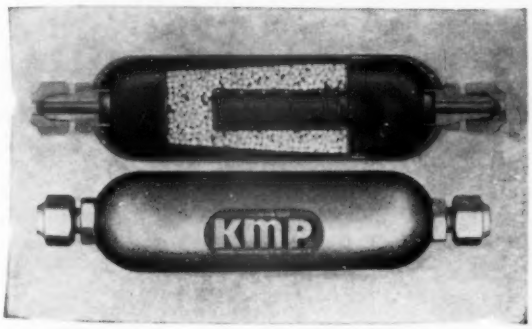
Strainers – Accumulators – Heat Exchangers

THE LARGEST SALE IN THE WORLD



Kenmore can supply a wide range of driers with standard connections or made to your specific requirements. The double inlet drier is KMP's newest design, this additional connection enables you to pull a vacuum on the high side of the system, which reduces the process time and ensures complete system evacuation. The single inlet drier can be supplied if preferred.

"The Little Giant"—For general field use on hermetic and open units up to $\frac{3}{4}$ h.p. using R.12. This drier comes to you dehydrated and sealed to ensure perfect dryness of the Molecular Sieve. KMP have designed this drier with the Service Engineer in mind, as the connections can be quickly flared or soldered to suit any application from capillary tube to $\frac{1}{4}$" flare.



Driers having flare fittings can be supplied filled with Molecular Sieve or Silica Gel. The large filter area incorporated in this range of driers ensures dirt free refrigerant throughout the system.

Kenmore Products are now available in this country, thus Kenmore can give you the quality, economy and service enjoyed by 80% of the Refrigeration Manufacturers in the United States of America.

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ISCEON 11 (CCl_3F)	23. 8°	74.8°
ISCEON 21 ($CHCl_2F$)	8.9°	48.0°
ISCEON 114 ($CClF_2\ CClF_2$)	3.6°	38.4°
	0°C	
ISCEON 12 (CCl_2F_2)	—29.8°	—21.6°
ISCEON 22 ($CHClF_2$)	—40.8°	—41.4°
ISCEON 13 ($CClF_3$)	—81.5°	—114. 7°
ISCEON 14 (CF_4)	—128°	—198.4°

Isceon chlorofluorocarbons are RELIABLE, having high levels of chemical and thermal stability, and are produced to very high purity specifications. Isceon refrigerants are SAFE—being non-inflammable and non-combustible. Their vapours are non-irritant and non-toxic in relatively high concentrations. Isceon refrigerants are available with boiling points of –128°C. upwards.

PRODUCTS OF IMPERIAL SMELTING

CONSOLIDATED ZINC CORPORATION (SALES) LIMITED, LONDON W.1

Micro sized
condensing unit.
Model COC4.
¼ HP—Height 15¼"
Diameter of
plate 11"

HPR

Compact. Lightweight Practical arrangement of components. Improved performance.

Quiet in operation.

This is one of the many exclusive and original H.P.R. designed units and components.

Heat Pump & Refrigeration Ltd. are Manufacturers of Heat Pumps and Refrigeration Equipment, and are consultants in every branch of Heating, Ventilation and Air Conditioning.

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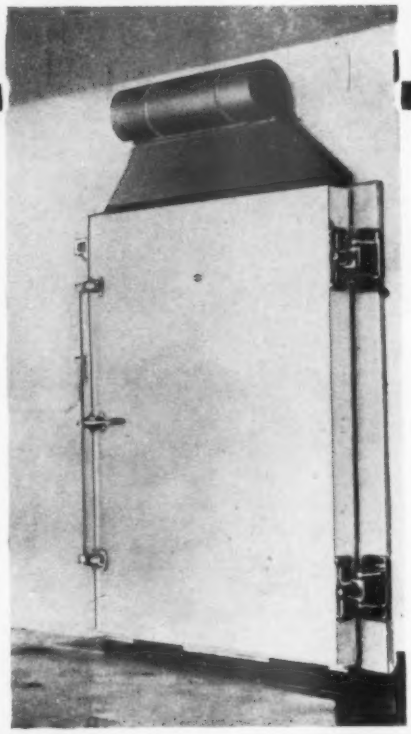
HEAT BARRIER – TODAY'S CONCEPT OF COLD STORE OPERATION



The "Heat Barrier" is an air curtain unit of revolutionary design. When the coldroom door is opened, powerful fans provide a carefully regulated screen of air which forms an effective barrier to ambient air currents. The door may be left open for long periods with negligible rise of coldroom temperature, providing unobstructed entry for personnel.

NEW POLYURETHANE CURTAINS

This important new development provides an alternative to rubber doors, offering unique advantages at low cost.

Remain pliable at cold store temperatures.

Use of transluscent material reduces the danger of accidents.

Nylon reinforcement for long service.

Special type of strip curtains available for refrigerated vehicles.

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"POLAR BLAST" technique solves this operator's problem

You cold transport operators have many problems. In distribution our expert Marketing Service has been tailored to help you.

We will supply you with a refrigerated vehicle best suited to your particular needs now—or for your future sales programme. Our engineers' designs for refrigerated body and chassis can give you 100% utilisation—this is what you want to make every payload pay.

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Call our Mr. Peter Wright today and get your refrigerated transport on to a profit-earning basis.

FOR THE LATEST NEWS ON THIS DEVELOPMENT contact

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Refrigerated Vehicle Suppliers

Attach this coupon to your letterhead and send to BLOX SERVICES LTD., London Road, Morden, Surrey or Phone MITcham 4533/5.

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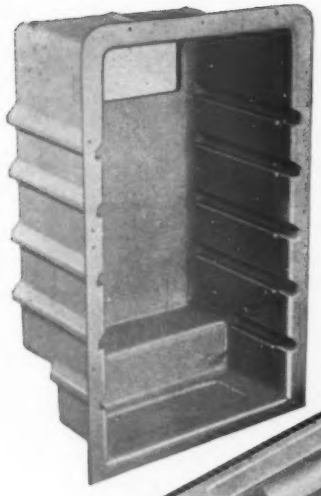
MR4



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Linings made from 'Flovic' vinyl copolymer sheet for the 'Colonial' refrigerator made by Lec Refrigeration Ltd., Bognor Regis, Sussex.

BECAUSE tough high-gloss 'Flovic' vinyl copolymer sheet shows little tendency to necking or thickness variation, even when considerable stretching is involved, it can be vacuum-formed into intricate, deep-drawn shapes. 'Flovic' is also easy to blank and drill.

High quality, excellent definition and good impact and tensile strengths are characteristics of mouldings produced from 'Flovic'. The complete absence in 'Flovic' of heavy metals and any harmful constituent, make this I.C.I. material ideal for the liners, door panels and other fittings in refrigerators.

'FLOVIC'

'Flovic' is the registered trade mark for the vinyl copolymer sheet and foil manufactured by I.C.I.

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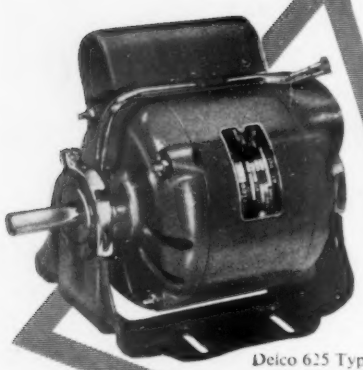
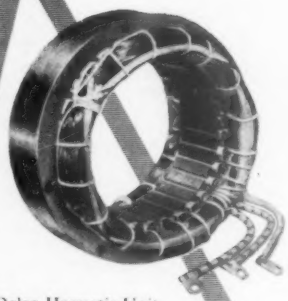


Delco 625 Type



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DELCO electric motors

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If you are designing new refrigeration equipment or redesigning old, you will find a Delco motor that's just right for the job. In addition to the renowned silent dependability there are exclusive features which make a Delco Motor the obvious choice for high quality equipment. Call in a Delco Engineer now to discuss present and future requirements, or write for further information.

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SITUATIONS VACANT

6d. per word. Minimum **12/6.** Box **2/-** extra.

VACANCY for qualified and experienced service engineer for commercial refrigeration in the East Midlands. A well appointed flat is available, suitable for married couple, without children. Write to Fred Hawkes (Refrigeration) Ltd., Polar Works, Park Road, Rushden, Northants. 176

STAL Refrigeration A.B.

NORRKOPING, SWEDEN

require

for their increasing commitments and export sales efforts :—

ONE PROJECT AND SALES ENGINEER

for the U.K. He should have extensive experience in industrial refrigeration and command good knowledge of the U.K. market. Experience in air conditioning applications a distinct advantage. He should have an H.N.C. or O.N.C. and for preference possess a Corporate Membership in professional Institution. The successful applicant should undergo training in the technical and sales departments in Sweden before taking up position in London.

ONE PLANT LAYOUT ENGINEER

with experience in large refrigeration installations. He should be prepared to take up abode in Sweden where he would undergo extensive training before taking active part in preparing and supervising installations abroad which may entail taking up position in London.

Command of Swedish Language not essential.
Five-day week in Summer, three weeks holiday.
Accommodation in Sweden arranged.

Applications should be sent in writing to De Laval Ljungstrom (Great Britain) Limited, 129, Kingsway, London, W.C.2, stating age, civil status, education, qualifications, previous experience, etc.

256

SALES ENGINEER required by Teddington Refrigeration Controls Ltd., Windmill Road, Sunbury-on-Thames, Middlesex. It is essential that applicants have previous engineering sales experience in the instrument field, preferably refrigeration. Applicants must be capable of conducting sales at all levels and preference will be given to applicants with an engineering qualification. Remuneration by salary plus expenses. Please write stating full details of previous experience, age and salary required to Group Personnel Manager, quoting reference number G.A.31. 264

SALESMAN—Experienced, Commercial Refrigeration for Hampshire by Main York Distributors. Established over 30 years. Good Salary, Commission, Car, Pension Scheme. Write in confidence Sales Manager, Carter & Finmore Ltd., Onslow Road, Southampton. 267

DESIGN DRAUGHTSMAN

required for interesting refrigeration equipment

New projects, good prospects

DRAUGHTSMEN

also required for new factory at Otford, Nr. Sevenoaks, Kent

Write in confidence stating experience, age, and salary required to:

Heat Pump & Refrigeration Ltd.,
Lansdowne Lane,
Charlton Village, S.E.7

237

ENGINEER, required fully trained all types refrigeration, willing to join Board of Directors. Reply confidence. 27 Beech Grove, Moulton, Northampton. 257

REFRIGERATION ENGINEER, fully experienced with Domestic and Commercial Equipment (including Air-conditioners). Kent Distributors. Hartford Electric Co., Water Lane, Maidstone, Kent. 255

REFRIGERATION ENGINEER required to take full charge of automatic ammonia and Freon cold storage plant. Experience essential. Leicester area. Apply, stating age and experience. Box 242. 242

Birds Eye Foods Limited

Lottbridge Drove, EASTBOURNE, Sussex.

Refrigeration Fitter for work on Ammonia and Freon Plant. Ammonia experience essential.

Five-day week, some overtime.

Apply in writing to Personnel Dept.

247

REFRIGERATION Service and Installation Engineer required. Capable of working without supervision and with experience of Domestic and Commercial equipment up to 10 h.p. Basic 42-hour week and overtime at National rates. Apply in writing in first instance to Refrigeration (Cornwall) Ltd. 27, East Street, Newquay, Cornwall. 244

SERVICE MANAGER: Manufacturer requires experienced Manager to operate Industrial Refrigeration Service Department in West London area. Top salary and car provided. Box 261. 261

ELECTRICAL FITTER (Refrigeration) required. Experience in refrigeration installation, maintenance and service essential. Present rate of pay 5/6¾d. per hour. N.J.I.C. conditions, including 42-hour, 5-day week. Holiday and Sick Pay Schemes, Optional Superannuation Scheme. Apply, by letter, within 7 days to Mr. E. B. Willis, District Manager, Midlands Electricity Board, Windsor Road, Redditch. 245

Air Conditioning Engineer

Desired for our Kingston, Jamaica, branch office. Design—estimate—supervise—all size installations. Piping experience helpful. Salary £2,000 - £2,500 annum. We are a world-wide organization with £20,000,000 in contracts underway. Good opportunity. Age 30 - 50. Send complete résumé with experience, availability, references, etc., to Wallace International, Inc., P.O. Box 6065, Terminal Station, Dallas, Texas, U.S.A.

243

PLANT ENGINEER with experience of heavy industrial ammonia refrigeration plant required by nationally known Company. Good prospects with non-contributory Pension Scheme. Write stating age, experience and salary required to Box 246. 246

EXPERIENCED Refrigerant Engineer required to take responsibility for service and commissioning in the North of England and Scotland. We are seeking a man with wide experience in the industry able to work on own initiative. The chosen applicant will be required to spend a period of time initially in Hereford for special training. Denco Miller Ltd., Holmer Road, Hereford. 252

APPLICATIONS ENGINEER

required by London distributor—York equipment, 1/5 h.p. - 15 h.p.

Write giving age, qualifications and previous experience to Metropolitan Refrigeration Ltd., 73 Charterhouse St., E.C.1.

248

REFRIGERATION ENGINEER Nigeria. British Company requires Senior Sales Engineer to take charge of their Refrigeration Division in Nigeria. His main task will be to expand sales—both domestic and commercial units—of first-class products with world-wide reputation in a market of great potential. He must have proven experience in the preparation of specifications and tenders for coldrooms and will supervise African installation and maintenance teams. The position offers considerable scope for a man with initiative and drive. Contracts 21 months. Paid leave. Basic salary dependent upon age and experience. Family allowances, free passages and furnished accommodation. Apply with full details quoting RSE81. to Box 253. 253

VACANCY for a qualified, experienced service engineer in the East Midlands, with progressive firm. A well appointed modern house is available for the successful applicant. 42-hour week plus overtime. Write to Fred Hawkes (Refrigeration) Ltd., 3/5 Park Road, Rushden, Northants. 218

MECHANICAL DRAUGHTSMAN—required by large industrial organization at London Head Office. Applicants must have good mechanical knowledge as applied to refrigeration and air-conditioning. Some experience of lay-out and detailing of food processing machinery an advantage. Good salary and prospects. Non-contributory Pension Scheme. Write giving age and particulars of experience to Box 213. 213

AGENCIES REPRESENTATIVES, ETC.

6d. per word. Minimum **12/6.** Box **2/- extra.**

EXPERIENCED REFRIGERATION SALESMAN required for South Wales area by old established Distributors. Apply in writing to: MacWhirter Limited, Service House, North Road, Cardiff. 227

AEROPHREZE

makers of commercial refrigeration cabinets and sales cases require:—

Sales Manager

to promote the sales of their equipment to refrigeration distributors throughout the British Isles.

THIS IS AN IMPORTANT APPOINTMENT WITH EXCELLENT PROSPECTS FOR THE RIGHT MAN.

ONLY THOSE WITH SALES EXPERIENCE IN THIS BRANCH OF THE REFRIGERATION INDUSTRY SHOULD APPLY.

Good commencing salary. Plus usual expenses.

Apply in writing to:—

AERO PIPE & GLASS CO. LTD.
HIGH STREET, YIEWSLEY,
MIDDLESEX

265

ARTICLES FOR SALE (Secondhand)

6d. per word. Minimum **12/6.** Box **2/- extra.**

APPROXIMATELY 100 Domestic second-hand Refrigerators for sale—no reasonable offer refused —individual or bulk Purchasers welcomed. Telephone MOUntview 3111 for appointment to view. 266

REFRIGERATION Cabinets second-hand, between 1½ to 40 c.ft. The A.C.R.E. Company, 389 Green Lanes, London, N.4. MOU 0171/2. 1364

PRESTCOLD A.S. 200 Refrigeration Unit. 20,000 b.t.u./hour, 3-phase supply with Heat Exchange, L.P. control; Expansion Valve, Distributor, Throttle Valve, Evaporator Coil, Unused and in new condition. Further details from Box 238. 238

CONDENSERS: Several large water economiser Condensers complete with fans and pump, capacities 40 and 60 tons refrigeration, for sale. Good condition. Also large stock of brine/water pumps 1 in. to 6 in. cheap to clear. Seen London. Alfred's Ices, 1/5 Hall Place, London, W.2. 239

STERNE TECUMSEH SEALED SYSTEM 5/7 cubic ft. 10 guineas each. Wilde & Clayton (Refrigeration Ltd.), 1 Hindsley Place, Forest Hill, S.E.23. Phone: FOR. 8851. 241

THREE 6 in. × 6 in. Ammonia Compressors, by J. & E. Hall, complete with motors, control gear and other ancillary equipment. For further particulars write Box 263. 263

BY J. & E. Hall Ltd. Freon 12 cross grid brine sparged air cooler having 1,300 ft. of 1¼ in. bore steel piping complete with casing and tray together with Thermotank centrifugal fan 9,000 c.f.m. 7½ h.p. motor and brine sparge pump with 3 h.p. motor. Plant originally installed in 1953. Cost to-day would be £1,400. Suggested price available on application, and inspection can be arranged in London. Box 262. 262

20 WINGET-DOLE VACUUM PLATES 6 ft. × 1 ft. connected in banks of five £20 all or £1 eacn. 5 h.p. Higgs single-phase repulsion motor, 230 to 250. £10. Service Fish Supplies. Phone RES. Bolton 27524. 251

FOR SALE: 1 h.p. Weir Compressor 3-phase, 230/250 volts A.C. current—perfect—price £65. ½ h.p. Frigidaire Flowing Cold Compressor, 230/250 volts A.C. —perfect—price £45. Box 259. 259

ARTICLES WANTED

6d. per word. Minimum **12/6.** Box **2/-** extra.

AMMONIA Refrigeration Compressors (Vertical) wanted by Hall, Sterne, Lightfoot with accessories, including Atmospheric Condensers—Offers: G. W. A. Jones, 15, Lancaster Gate, London, W.2. Telephone Paddington 4317. 236

SECOND-HAND COLDROOMS WANTED—Collections for cash, all parts British Isles—Scanfrost Distributors—5, Clive St., Bolton, Lancs. 240

MISCELLANEOUS

6d. per word. Minimum **12/6.** Box **2/-** extra.

"HOMEFREEZE" Ice-Lolly Packs for domestic refrigerators and other types of lolly moulds, sticks and compounds. Trade discounts, etc. from the manufacturer R. G. Harsant, 65, New Road, Ware, Herts. 170

COLDROOMS (new). Amazing bargains. Suit all trades. Ideal for service engineers fitting their own equipment. All sizes available. State requirements. Servome Ltd., 273, Farnborough Road, Farnborough, Hants. (Farnborough (Hants.) 157). 235

SECTIONAL cold rooms for all temperatures up to 5,000 cubic feet capacity. Highest quality, competitive prices. Trade enquiries invited for illustrated leaflets and quotations. Insulated Storage and Display, 28-30 Hempsted Lane, Gloucester. Telephone 20649. 249

POLYTHENE Coated Steel Shelves, Freezer and Supermarket Baskets, Hygienic Corrosion Proof White Polythene, Special Discounts for Quantities. Richard Craven & Co. Ltd., Camwal Road, Starbeck, Harrogate. Telephone 84484. 203

BUSINESS OPPORTUNITY

6d. per word. Minimum **12/6.** Box **2/-** extra.

WISH YOU COULD RETIRE? We are! Our business would provide excellent future for newcomer. Would sell long established refrigeration company holding valuable commercial and domestic agencies for both sales and service. Extensive main road showrooms, stores, vans and stock. Delightful part of West Country. Box 254. 254

REFRIGERATION Sales and Service. Commercial, Industrial, Domestic. Old established Midlands firm showing consistent profits. Fully staffed. Excellent showrooms, workshops, storage facilities. Fleet of vehicles. Extensive service and maintenance connections. Box 260. 260

SERVICE & REPAIRS

6d. per word. Minimum **12/6.** Box **2/-** extra.

REPAIRS overhauls and general maintenance effected for the trade. Specialists in absorption and Sealed Unit Mechanisms. The A.C.R.E. Company, 389 Green Lanes, London, N.4. MOU 0171/2. 229

TRADE SERVICES

6d. per word. Minimum **12/6.** Box **2/-** extra.

QUALIFIED REFRIGERATION ENGINEER would act as Consultant, prepare Estimates, Designs, Technical advice A complete Consultant Service for the small Company.—K. G. Hobbs, A.M. ASHRAE., A.M.INST.B.E. A.M.INST.R., Tel.: PRImrose 4487 83

PARTNERSHIPS

6d. per word. Minimum **12/6.** Box **2/-** extra.

PARTNER required, well established Refrigeration Company Control Sales, Engineers, reply in confidence, 27 Beech Grove, Moulton, Northampton. 258

AUCTIONS/TENDERS

6d. per word. Minimum **12/6.** Box **2/-** extra.

FOR SALE—HEAT PUMP EQUIPMENT

The following equipment is surplus to requirements and is offered for sale. It can be inspected (by appointment) at the Sub-Area Workshops of the Eastern Electricity Board, 4, Duke Street, Norwich, Norfolk. Tenders to be submitted for the whole or part of the equipment.

Offers should be made in writing to the Secretarial Officer at the above address in an envelope marked "Tender for Heat Pump Equipment." The Purchaser(s) must collect the equipment.

The Board do not bind themselves to accept the highest or any tender. Tenders must be received within one month of the appearance of this advertisement.

3 - 5 H.P. HEAT PUMPS. Water to Water each comprising:—**One Prestold 5 H.P. Motor Compressor Assembly, Serial Nos. 101, 102, 103; One Compressor Base Frame; One Flexible line assembly discharge; One Flexible Suction line; Four Spring Compressor Mountings assembly; One Liquid Receiver 35 lb. Freon 12; One Heat Exchange Condenser; One Safety Thermostat (Ranco); One Searl-Bush Model 200XS Heat Exchangers; One 230/250 volt ⅜" Solenoid Valve ⅜" Flare; One Sightglass Danfoss S.G. ⅜"; One T.E. Valve Danfoss Ref. TVF8; One H/P & L/P Cutout Danfoss; Two EVM50 Solenoid Valves Danfoss; Two Maxheat Oval Tubular Heaters 1 ft., 80w.; One Class 9012 type ACW 3 pressure switches; One Pressure Gauge CGA/PBL/1; One Pressure Gauge PGA/PBD/1; Four 2" No. 71 Kontite gate valves; Four 2" No. 3 Kon to male gas fitting; Two 2" No. 13 Tee with ¼" branch; Two 2" x 1¼" 75/76/77 Reducing Set; Six 2" No. 26 Bends; Two 2" No. 2 to 2" Female gas fitting; Two 2" No. 2A to 1¼" Female gas; Focr ¼" No. 31 Male Gas Bends; Two ¼" No. 12 Tees.**

SPARES. One 5 H.P. Prestcold Valve Plate; Three Sets Gaskets; Three Sets Reed Valves complete; One 1 H.P. Air to Air Heat Pump (Heating or Cooling); Temkon Model M200 CHP (used).

NEW. One Class 9012 Type ACW; Three Pressure Switches; Three 2¼" Female O/D x 1¼" Female I/D copper reducers for silver soldering; Two Model 123 Rotameters with ¼" SAE male connections in gunmetal. Fitted perspex front windows, stainless steel Float and Neoprene, packing gland. Tube size 18.400 calibrated 2 - 20 lbs./min of Freon 12 at 90°F. x 100 p.s.i.g.

KONTITE FITTINGS (new and unused). One 3" No. 71 Gate Pattern Wheel Valve; One 3" No 12 Tee; Four 3" No. 13 Tees with 2" reduced branch; Two 3" No. 13A Tees with 2" end; Three 3" No. 13B Tees with 2" branch and 2" end; Nine 3" No. 26 Elbows; Two 3" No. 1 Couplings; Two 3" No. 3 Kon to 3" Male Couplings; Four 3" No. 13C Tee reduced 2" both ends; Twelve 2" No. 26 Bends; Twelve 2" No. 27 Cones; One No. 63 ¼" Kon Plug Cocks; Twelve 2" Lockshields; Four 2 Loose Keys; One 3" Lockshield; Two 3" Loose Keys; Two 1¼" No. 71 Valves; Two 1¼" No. 71 Valves; Twelve 2" No. 13 Tees with ¼" Branch; 16' 6" 2" Copper Pipe; Two No. 13 1¼" x ¼" Tees; Two No. 13 1¼" x ¼" Tees; Eight No. 76 2" Cones. 268

MODERN REFRIGERATION
and Air Control

Incorporating
COLD STORAGE AND PRODUCE REVIEW
and ICE AND COLD STORAGE

Established 1898

VOLUME 64 NUMBER 758

MAY · 1961

Contents

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Telephone: HOP 5712 Telegrams: Buns, Souphone, London

Editorial...

Sea (Food) Power

British Shipbuilding, 1960

Air Traffic in Food

● Having been dependent since the Industrial Revolution on overseas food, the British have had as a major preoccupation, at least for the past 82 years, the building of efficient perishable cargo carriers. Indeed, no country on earth has been as well served by its specialized merchant marine as has this nation.

● The drying up of shipbuilding orders in the general passenger liner category in 1960 did not apply to refrigerated tonnage. According to Lloyd's Register of Shipping, the refrigerated cargo capacity classed by the society in 1960 was twice the amount classed in 1959, the capacities of the 87 new and 5 existing ships completed under supervision and granted certificates last year totalling over 10,000,000 c.ft. Major alterations or extensions were carried out on another 12 installations. At the time of writing, work is on hand on 82 new ships. An interesting feature of the refrigerated produce trade was that there was also a substantial increase in the number of containers classed for marine transport ; 42 were constructed and tested under the inspection of the society's surveyors, compared with 54 in the previous seven years. Refrigerating plants for air-conditioning, much larger than required in any refrigerated cargo ship, were constructed under supervision for several large passenger ships. Survey and testing of domestic refrigerating installations in 12 new ships were completed and 30 more were in hand. The society's certificate in 1960 was granted to 18 cold stores, with a total capacity of about 3,000,000 c.ft. Surveys at the turn of the year were in progress on another 15 stores and extensions to existing stores totalling 3,500,000 c.ft.

● An interesting addition to the fleets plying to and from Britain was inspected by " M.R." last month. This ship, C.P.R.'s new *Empress of Canada*, is described fully on another page. A special feature, not previously encountered, of the provision stowage spaces in the vessel is the result of much thought and detail work on the part of the naval architects in arranging supplementary stowage facilities adjacent to both the dry provisions rooms and the domestic refrigeration chambers. This extra provision stowage space is required only when the vessel cruises ; on the regular North Atlantic Service it will be utilized to good advantage in the drive for increased cargoes between Canada and Great Britain—an excellent example of method planning with precious space.

● Several new features in shipboard catering have been introduced into the kitchens and serveries of the *Empress of Canada* while retaining the best of the old and well-proven ideas that have stood the test of time and experience. Canadian Pacific can be proud in their claim to be amongst the pioneers in British Shipping Lines with up-to-date and hygienic methods of handling fresh milk and cream. This has always in the past presented a hygiene problem on board ship, but not in the *Empress of Canada* where specially designed chilling dispense cabinets have been installed and milk churns manufactured specially to the company's specification have been supplied. This innovation is comparatively new to this country, but it is extensively used and indeed insisted on by the public health authorities on the North American Continent for the safe handling of fresh milk from the dairy to the consumer.

● The news that a considerable air traffic in cut meats is about to be opened up between the Antipodes and Britain did not colour the Rt. Hon. the Viscount Simon's outlook when making his presidential address to The Institute of Marine Engineers last month. " I believe that we can look to increased interchange of goods between countries separated by the oceans of the world," declared Viscount Simon. " Is it possible that a substantial proportion of this traffic will in years to come be carried by air ? I would not deny that it is possible. But all the indications at present are that under any conceivable system it must be less economical to carry goods through the air, where energy must be expended on maintaining the vehicle in its chosen medium, than through the sea where the ship enjoys natural flotation. The main advantage of air transport, which is speed, may sufficiently appeal to passengers to justify the payment of higher fares—fares that are substantially higher if the " hotel " element of the fare by sea is removed for purposes of comparison. But I see little chance that the extra cost of conveying goods by air as compared with conveying them by sea would ever be justified except in special cases."

● " I have never seen anything like it before," said Mr. Frederick Erroll, Minister of State to the Board of Trade, who flew in to Swansea last month to see Prestcold's new £5,000,000 refrigerator factory. Cause of the astonishment was the factory's five-and-a-half miles of overhead conveyor system which webs the roof in a giant overhead marshalling yard for refrigerators in all stages of construction. Its control room, a complicated mass of flashing panel lights and indicators, has been likened to a modern railway signal box. Mr. Erroll, a highly qualified engineer in his own right, was shown over the plant by Mr. K. J. R. Cocke, director and general manager of the Prestcold Division, Pressed Steel Co. He commented afterwards that he was even more impressed than he expected to be—particularly with the high standard of engineering design and research which went into Prestcold products.

● These remarks could be taken as a fitting epitaph to the late Mr. Eric Rowledge whose sudden death is reported on the opposite page. Mr. Rowledge's unremitting efforts, before and after the war, to place British domestic and commercial refrigeration on the highest possible plane contributed greatly to the final realization of the colossal enterprise in South Wales. In saying this, Mr. Cocke's vital part in launching the Swansea plant has not been overlooked.

● The demand for domestic refrigerators has improved slightly, according to the February figures just issued by the Domestic Refrigeration Development Committee. Manufacturers' deliveries of domestic refrigerators to the home market during February totalled 54,827—a decrease of 36 per cent on February of last year, when deliveries reached 85,994. (The January figures showed a comparative decrease of 46·5per cent.)

International Refrigeration Fair TO BE HELD IN LONDON IN 1962

The International Refrigeration Fair will be held for the first time at the Grand Hall, Olympia, London, from April 13 to 19, 1962.

Sponsored by the British Refrigeration Association, and supported by The Domestic Refrigeration Development Committee, The Institute of Refrigeration, and The National College for Heating Ventilating Refrigeration and Fan Engineering, the Fair will be comprehensive and display all aspects of the important refrigeration industry to the many thousands in this country who are concerned with it and its many ancillaries. Overseas interest is also certain to be great and the Fair should certainly result in many export orders and answer the plea of the President of the Board of Trade for Britain to increase export business.

The fact that sponsorship and supportof the Fair are in the hands of the Refrigeration and allied Associations will assure its success.

Further details of the International Refrigeration Fair, which is being organized by Contemporary Exhibitions Ltd., 2, Dunraven Street, Park Lane, London, W.1, will be announced in the near future.

OBITUARY

Mr. Eric G. Rowledge

AN extremely wide circle of friends in the refrigeration industry were grieved last month to learn of the sudden death of Mr. Eric George Rowledge. A local director of The Pressed Steel Company Limited and the senior director of the Prestcold Division, he died at Swansea during a visit to the Prestcold factory on the 19th ultimo.

The death of Mr. Eric Rowledge removes one of the outstanding figures of the British refrigeration world. Born 62 years ago at Peterborough into an engineering family he derived in his early years an accumulation of knowledge from his father and benefited from the example of his uncle whose name is indissolubly linked with the design and engineering features of Rolls-Royce.

He served his apprenticeship with Peter Brotherhood and received his orthodox technical education at Deacon's School, both in his home town. Becoming of military age during the first world war, he served for over a year in the Royal Engineers. After demobilization, he was employed in the drawing office of Peter Brotherhood and became an air compressor designer with a flair for tooling. To further his experience he transferred his activities to Reavell & Co. Ltd. of Ipswich, again on air compressor design.

The transformation of the refrigeration compressor scene from the open type, slow-speed machine to the enclosed type, quick-revolution compressor was the occasion for his entry into the refrigeration field. In the middle 1920s he joined Wm. Douglas & Sons Ltd. of Putney and designed and engineered for them their range of enclosed ammonia compressors.

In the late 20s and early 30s he was with J. Stone & Co. Ltd., Deptford, engaged on the adaptation of the P.I.V. reduction gear and Lightfoot Ellarcold refrigeration to railway rolling stock. This pioneer work gave him the freedom of one of the railway lines at night-time between London and the coast and led to world-wide travel, establishing refrigeration as an essential on the railways of many countries.

When the Pressed Steel Company entered the refrigeration field he became around 1933 the first chief engineer of their refrigeration division which traded, then as now, as Prestcold. This appointment gave full scope to his design and tooling knowledge and experience, and after the war he became a local director and ultimately senior director of the Refrigeration Division (Prestcold) of the Pressed Steel Company. Through their works planning committee he played an important role in recent months in the transfer of Prestcold manufacturing and engineering plant and personnel to South Wales. Fourteen years ago he put into operation the then extremely advanced mass production plant at Cowley which gave his company such a fine post-war start in domestic refrigeration.

He was also active in Association affairs, and was the current chairman of the British Refrigeration Association and also of the Domestic Refrigeration Development Committee.

He had an attack of coronary thrombosis about 10 years ago, with recurrences since, but such was his enthusiasm for life, and, in particular, for his job, that he recovered sufficiently to enable him to resume his abnormally busy career.

It was on Tuesday, April 18, 1961, that he held a board meeting at Swansea and a production meeting on the following morning. On the completion of the latter he collapsed and died.

He was cremated at Swansea and a memorial service was held at St. Aldate's, Oxford, at 12 noon on Wednesday, April 26.

Mr. T. Whittaker, director of the British Refrigeration Association, writes: "The passing of Eric Rowledge has saddened his many friends in the British Refrigeration Association and his strong presence will be greatly missed from our meetings. He was unusually well informed about the refrigeration industry and the generosity with which he placed his knowledge and experience at the disposal of his colleagues was greatly valued. His courage and cheerful way won him much loyalty and affection and it is a privilege to have been able to call him a friend."

Mr. Claude Simmonds, secretary, DoRDeC: "Eric Rowledge was more than just the chairman of DoRDeC—important though that position is. He was the friend of every member of the committee and unremitting in the interest he showed in its work for the domestic refrigeration industry. He was always willing and anxious to meet every demand—and there were many of them—that DoRDeC made on his time. Above all, he brought to its diverse activities a supreme blend of adjustment, experience and cheerfulness. He was much loved and he will be sorely missed."

NEWS OF THE MONTH

Refrigeration and A-c Exports.—During March, 1961, air-conditioning and refrigerating machinery and fans (commercial and industrial sizes) to the value of £1,170,436 weighing 1,787 tons was exported from the United Kingdom. Comparable figures for March, 1960, were 1,246 tons, worth £885,503.

* * *

Exports' Analysis.—Of the 1,787 tons of air-conditioning and refrigerating plant worth £1,170,436 exported by Great Britain in March—quoted in the preceding paragraph—92 tons went to the Union of South Africa, 26 tons to India, 45 tons to Australia, 48 tons to New Zealand, 39 tons to Canada, 249 tons to "other Commonwealth countries," 174 tons to Eire, 32 tons to Sweden, 232 tons to Western Germany, 95 to the Netherlands, 135 tons to Belgium, 69 tons to France, 25 to Italy and 526 tons to "other foreign countries."

* * *

Refrigeration Plant Classified.—Of the total exports of air-conditioning and refrigeration machinery during March, commercial refrigerating machinery accounted for 287 tons worth £153,041, industrial plant and equipment for 481 tons worth £248,631, and refrigerating machinery, equipment and parts for 662 tons worth £484,610.

* * *

Exports of Small Refrigerators.—During March, 1,416 tons of complete refrigerators and domestic refrigeration equipment were sent overseas from Great Britain. These exports were worth £880,862. The 1,416 tons comprised 14 tons to the Union of South Africa, 6 tons to Rhodesia and Nyasaland, 58 to New Zealand, 71 tons to Canada, 474 to "other Commonwealth countries and Eire," 51 tons to Sweden, 101 tons to Western Germany, 25 tons to Italy and 616 tons to "other foreign countries.

* * *

Kippers for Russians.—Russians at the 1961 British Trade Fair in Moscow will have the chance to develop a taste for kippers, bacon and haggis. On May 1, a convoy of long-haulage vehicles left London for Moscow, loaded with foodstuffs for the fair. In the convoy was a large semi-trailer unit fitted with the latest vehicle refrigeration system, manufactured by L. Sterne and Co. Ltd. of Glasgow, Scotland. This vehicle is carrying about three tons of English kippers, a large quantity of bacon and a variety of other frozen foods including haggis. In all, 10 tons of produce occupying 1,000 c.ft. of fully-refrigerated space will be driven the 1,750 miles overland to Moscow, in the Sterne-cooled trailer, powered by a Commer 12-ton tractor supplied by the Rootes Group, it is the first of its type to make the London-Moscow overland trip.

* * *

HOTPOINT'S FORTIETH ANNIVERSARY

An exterior view of Hotpoint's Home Centre near Oxford Circus, London. A showroom, working demonstration area and lecture theatre are the main features of the Centre to which the public are invited to take along their housecraft problems. It was here that Hotpoint last month celebrated the 40th anniversary of the first appliance bearing their name.

NEW "LIGHTFOOT" MERCHANDISER

Refrigerated frozen food cabinets, in their various forms and sizes, are now commonplace in almost every shop selling foodstuffs and, by weight of numbers, have been instrumental in steadily increasing the sale of this type of product. **The Lightfoot Refrigeration Co. Ltd.,** who have been responsible for many major developments and refinements to equipment in the refrigeration field, have now produced a brand new cabinet designed to expand sales of frozen foods by altering selling routine. This unit, which they call the "Imp," is not a storage cabinet, but a new method of presenting packaged foods to the public in a tempting, eye-catching manner, in order to stimulate impulse buying or promote the sale of slow moving items. It can be strategically positioned in the aisle of a shop or store and will not, therefore, occupy valuable counter space. Experiments already carried out with prototypes have resulted in sales increases of up to 500 per cent. on single items. The cabinet is of extremely attractive and compact design and is finished externally in hygienic non-chip, scratch resistant fibre glass, with black stove enamelled aluminium base. The outer

and inner shells are permanently bonded together with a new improved type of insulating material resulting in a rigid, yet light, single piece assembly. The welded aluminium storage tank, which is finished in stove enamel to prevent "tasting" of the foods, has a capacity of 3·8 c.ft. and will hold approximately 18-gal. of packaged ice cream or 1-cwt. of packaged frozen foods (this will vary slightly according to the type of food being offered.) A refrigerated centre plate can be provided and is recommended for use wi h ice cream ; it will also prove invaluable where two types of foods are being offered in the same cabinet. The unit is mounted on oversize, lockable type castors which combine easy handling with stability when in position and the "taper" design of the cabinet facilitates stacking, by multiple users, when the store is closed. Tubular super-structures, to which can be affixed brand indicators, price reduction offers or advertising slogans, are available. These may be of the illuminated or non-illuminated type and are quickly and easily in-

stalled by inserting into holders on opposite sides of the unit. Efficient refrigeration is an essential where this type of equipment is concerned and the manufacturers have paid particular attention to this by providing a 1/4 h.p. unit, with oversized air cooled condenser, to cope with the most severe operating conditions. The refrigeration unit, which is completely self-contained and has merely to be connected to an adjacent electrical outlet to put the cabinet into operation, is housed in the base of the unit. The special design of the base prevents air from blowing on to the legs of customers.

* * *

The Engineering Centre announces that towards the end of the year it is moving to considerably larger premises. In addition to a greatly expanded engineering exhibition, a building centre, affiliated to the London Building Centre, will be established. These and many other activities are reported tn the monthly newsletter circulated by the Centre. The newsletter is intended to give exhibitors and other interested organisations an insight into the various activities of the Centre and to encourage all those interested in engineering to make use of its extensive facilities. The current issue gives amongst other things details of the exhibitors at the 1961 Leipzig Spring Fair.

PICTURE OF THE MONTH

★

This recent aerial photograph of the factory of Lec Refrigeration Company Limited at Bognor Regis, Sussex, reveals the considerable size of this fast-developing enterprise.

Progress in Thermoelectric Cooling Devices

By R. VINEY BROWN, B.SC. (ENG.), GRAD.I.E.E., S.I.MECH.E., GRAD. INSTR. (Technical Director, C. W. Brown (Engs.) Ltd.,

Summary

Recent advances in the technology of semiconductor alloys have led to the development of thermoelectric cooling devices for medical and electronic applications. The unique advantages of thermoelectric cooling are evaluated and constructional details given of several laboratory cooling units.

Introduction

IT is well known that the performance of a thermoelectric cooling battery is dependent on the properties of the semiconducting alloy used in its construction. Devices which utilise an alloy called

Fig. 1.

bismuth telluride give a maximum temperature depression of 80° C. at a mean temperature of 20° C.

A typical cooling unit consists of a battery of bismuth telluride couples connected in series by copper strips. The battery is arranged so that heat is absorbed on the upper surface and evolved on the lower surface, the copper connecting strips serving both as electrical conductors and for heat transmission. The battery is clamped between the object to be cooled and an air- or water-cooled heat sink. A thin layer of electrical insulation must be interposed between the battery and the contacting surfaces to prevent the couples being short circuited.

The cooling rate is controllable by varying the d.c. operating current. Heat may be pumped in the opposite direction reversing the polarity of the supply. If the cooling unit is powered by rectified a.c. a smoothing circuit should be employed to reduce the ripple content below 10 per cent.

Applications

(1) *Medical*

The quick response and accurate temperature control of thermoelectric systems is of particular importance for medical applications. Thin sections of animal tissue are frequently obtained by freezing the specimen prior to the cutting operation. A microtome freezing stage developed in our laboratories is shown in fig. 1. A thermoelectric battery

Fig. 2.

1 in. square by ¼ in. thick is used to cool a metal plate 1½ in. in diameter. The plate is provided with concentric grooves to anchor the tissue to be sectioned. A water-cooled heat sink ensures a stable operating temperature. The complete device is encapsulated in plastic for protection against mechanical shock. The power supply unit (fig. 2) converts mains electricity into low voltage d.c. to

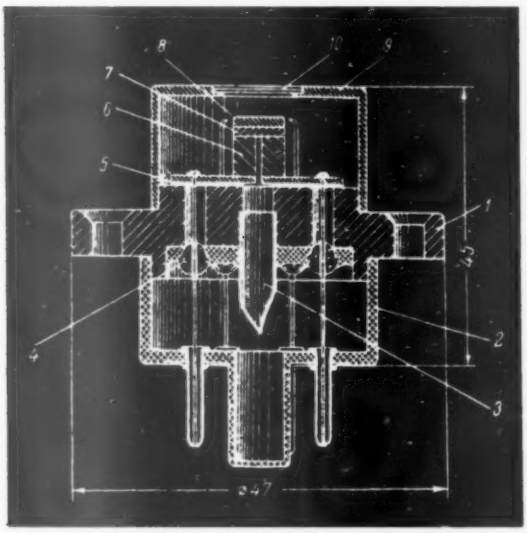


Fig. 3.

KEY

1 = Aluminium base plate.
2 = Plastic case.
3 = Tube for providing evacuation of the inner volume.
4 = Insulators for electrical leads from octal socket.
5 = Epoxy resin forming a hermetic seal.
6 = Semiconductor thermoelement.
7 = Cold junction of thermoelectric couple.
8 = Photoresistor.
9 = Cap.
10 = Mica window which is fixed to sheel with epoxy resin.

operate the cooling battery. A sensitive control enables the temperature of the microtome table to be varied to any desired value down to −15° C.

The system eliminates the inconvenience of CO_2 cylinders used in conventional cooling apparatus. Accurate temperature control prevents damage to the microstructure of tissues and enables the optimum cutting temperature to be maintained indefinitely.

A modification of this device facilitates the cooling of specimens during microscopic examination. For this application the current may be reversed to provide a controllable heating effect when required.

(2) *Spot cooling Electronic Devices*

The cooling of solid state devices brings about a significant decrease in the noise level and permits operation in environments whose temperatures would normally be prohibitive.

The cooling device shown in fig. 3 reduces the temperature of a photoresistor by 50° C. below the surrounding ambient. The use of microthermistors provides temperature control to within ±0.1° C. In addition to reducing the noise level the threshold sensitivity moves into a longer wave part of the spectrum and the danger of instability is eliminated.

Other applications include the temperature stabilization of electronic circuits and frequency control crystals. The highest accuracy known was achieved by Russian scientists at a level 20° C. ± 0.001° C. for stabilization of a standard cell.

Laboratory Temperature Reference Devices

The use of melting ice for the stabilization of thermocouples is generally an inconvenient practice. A thermoelectric device has been developed which automatically maintains a temperature of 0° C. A cross section through the device is shown in fig. 4.

The inner ampule is filled with distilled water, the lower half of which freezes due to contact with the thermoelectric cold junction. A nickel cup supported by a slender leg reduces the temperature gradient. Any external temperature changes do not affect the instrument since the balance of water and ice will absorb any such variations.

A similar device used for the calibration of thermometers is shown in fig. 5. Conventional methods of standardization which depend on fixed points are inherently inaccurate due to variations in the capillary diameters of thermometers. In this instrument, however, a continuously variable temperature environment is available which facilitates calibration to any desired degree of accuracy.

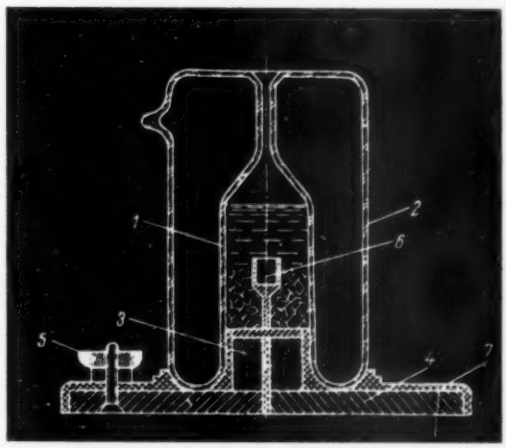


Fig. 4.

KEY

1 = Inner glass ampule.
2 = Vacuum shield.
3 = Semiconductor thermoelement.
4 = Semicircular copper discs which form electrical connexion to the couple and serve to dissipate the heat evolved.
5 = Electrical terminals.
6 = Nickel cup.
7 = Epoxy resin to provide rigidity.

The available temperature range is −30° C. to +60° C. A suitable working fluid for low temperature use is a mixture of spirit and water. For higher temperatures oil may be used.

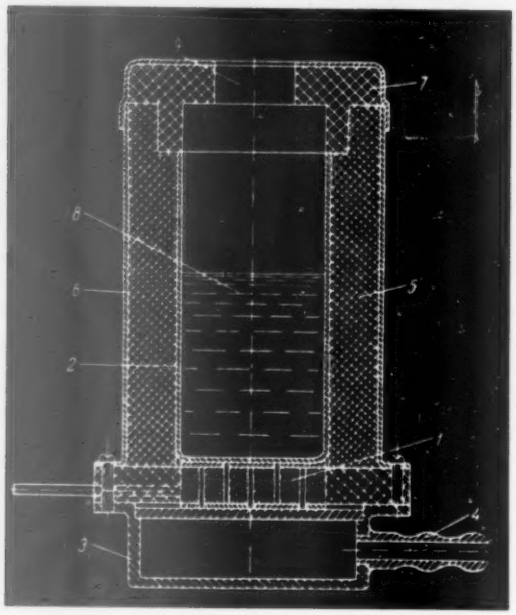


Fig. 5.

KEY

1 = Semiconductor thermoelements.
2 = Inner lining.
3 = Water cooled heat sink.
4 = Water pipe connexion.
5 = Thermal insulation
6 = Outer casing.
7 = Lid.
8 = Working fluid to promote good heat transfer.
9 = Aperture in lid to admit thermometers.

Conclusion

The foregoing should give some idea of the scope of thermoelectric cooling for laboratory apparatus. There are many other applications such as dew point hygrometers and vacuum cold traps which have been described in detail elsewhere. At present, economics prevent the use of thermoelectric refrigeration in the domestic and commercial sphere. However, improvements in materials and further progress in manufacturing techniques could result in competitive thermoelectric systems up to 300 B.t.u./hr. in the near future.

The author acknowledges use of certain information in this article from the U.S.S.R.

CLARENDON LABORATORY VISIT

This year the summer visit by members of the Low Temperature Group of the Institute of Physics will be to the Low Temperature Department of the Clarendon Laboratory, Oxford, by kind invitation of Professor B. Bleaney, F.R.S. The visit will be on Friday, June 9, and will commence at 11 a.m. and end at about 4 p.m. Participants will make their own travel arrangements.

New Sussex Store.—Last month the Mayor of Eastbourne officially opened the new cold store and amenities block at Birds Eye Foods Ltd.'s Eastbourne factory. Birds Eye Foods Ltd. is a comparative newcomer to Eastbourne but the factory buildings were opened some years ago by the Times Food Products Co. Ltd. Until May, 1959, when Birds Eye acquired Times Food and its four subsidiaries, the business was largely devoted to food wholesaling—mostly in bakery and confectionery products. In 1956, however, the company launched its first quick-frozen product, the now widely known Tempo, dairy cream sponge. Birds Eye sponges are now also made there. Small by Birds Eye standards, the new 70,000 c.ft. cold store is one of the largest in the South of England and will hold frozen foods produced in the factory at a temperature of −5° F. This is a single span building with no intervening pillars or supports and is designed for palletized operation. The fork lift truck is used for stacking within the store and for carrying case loads of frozen foods to the refrigerated vehicles at the loading bank outside. Quick-frozen foods are taken from the factory to the 43 distribution depots, strategically placed throughout the United Kingdom, by a 14 ton E.R.F. (6LW) insulated vehicle, specially designed for palletized loading. The foods are kept at a temperature of 0° F. inside the vehicle. The 7/8 ton mechanically refrigerated vehicle has been designed for the long distance transport of light-weight products such as sponges.

New Frozen Food Holding Cabinet

Newly available from Frigidaire is the "Junior Zero-Store," model VFR-138, a vertical low-temperature storage cabinet designed to hold stocks of frozen foods in hotels, restaurants, canteens and shops. The new cabinet is a smaller version of the well-known Frigidaire "Zero-Store," which has done so much to popularize the use of frozen foods by caterers since it was introduced 18 months ago.

At the forthcoming British Trade Fair in Moscow, the Cambridge Instrument Company's representatives, Mr. W. E. Lamb, director, and Mr. M. J. C. Cassidy, publicity manager, will renew and deepen business contacts and personal friendships made during the highly successful June 1960 exhibition of British Scientific Instruments in the Polytechnic Museum, Moscow. Over 60,000 technical publications in Russian and English will be available on the Cambridge stand (C10) which the company is sharing with its associates Electronic Instruments Ltd., of Richmond, Surrey.

S.S. *Empress of Canada*

CANADIAN PACIFIC'S new s.s. *Empress of Canada* sailed on her maiden voyage from Liverpool last month. She has been proudly acclaimed by her builders, Vickers-Armstrong (Shipbuilders) Limited, as a splendid example of a British shipyard's skill and ability to meet the challenge of ever-increasing competition and is thought by her owners to be an outstanding addition to their post-war fleet.

The *Empress of Canada* is a fully air conditioned ship with personal temperature control in all the passenger accommodation, and the air-conditioning equipment has been specially designed for easy economical operation using high pressure distribution. Indeed, this is the first full-scale application of the new "Marinair"* air-conditioning system for passenger ships.

The vessel of 27,300 gross tons and 650 ft. in length has been constructed to comply with the latest Ministry of Transport requirements for foreign-going passenger vessels, and also to the highest class of Lloyd's Register of Shipping. In addition special attention has been paid to the severe conditions imposed by North Atlantic service.

The Canada Room is of unusually lofty proportions.

The modern tendency is to produce a vessel with piled-up superstructure, but this has been avoided in the case of the *Empress of Canada* and although the upperworks are somewhat higher than the corresponding features of the *Empress of England* and *Empress of Britain*, its silhouette is low in comparison with those of other vessels of equal size.

The structural design is comparable with that of the *Empress of Britain* which is more advanced than that of any previous large passenger vessel built in Britain for the North Atlantic trade, involving a combination of longitudinal and transverse framing and employing welding to a far greater extent than is general for a vessel of this class.

* "Marinair" is a registered trademark. Carrier Engineering Company has applied for patents to protect the exclusive features of this system.

The vessel is propelled by twin screws, the power being provided by two independent sets of double reduction geared turbines, of Pametrada design, working on a reheat cycle. The machinery is designed for a service s.h.p. of 27,000 and a maximum of 30,000 with propeller revolutions of 123 and 127 per minute, respectively.

There are five holds, arranged three forward and two aft, and the bridge has been so disposed that nos. 1, 2 and 3 hatches are forward of the bridge, thus giving unrestricted open deck space abaft the

Air-conditioning grille in cabin.

bridge for passenger accommodation and keeping the cargo working arrangements clear of the passenger spaces to a maximum extent. No. 2 hatch is a large hatch and is arranged for the carriage of motor-cars in tiers on MacGregor hatch covers of such a type as will facilitate rapid discharge. No. 4 cargo space is served by twin hatches and No. 3 hatch is arranged to serve the refrigerated cargo and provision chambers, and also baggage and mail rooms. All hatches are served by 5-ton derricks with the exception of No. 2, where 10-ton derricks are fitted.

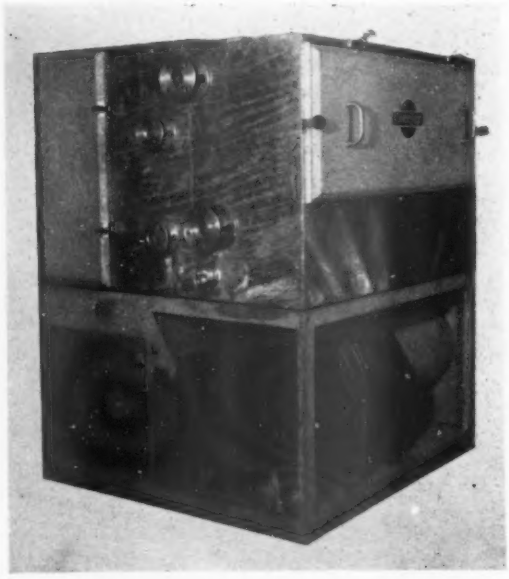
The refrigerated cargo capacity of this ship is 19,420 c.ft. while the insulated storeroom space measures 19,625 c.ft.

As mentioned above, The Canadian Pacific Steamship Co. has taken much trouble to ensure that their new flagship is fitted with the best possible equipment for comfortable and efficient running both on the North Atlantic service and as a cruise ship. In accordance with this policy, the liner is air-conditioned throughout with the new "Marinair" air-conditioning system designed and installed by Carrier Engineering Co. Ltd., London.

The system has been designed from first principles around the basic requirements of ease and economy in operation, ease of maintenance and economy of space. High velocity distribution is used with a terminal unit specially designed for cabin spaces so that passengers may adjust the temperature to their liking without unbalancing the system.

Twenty-seven compact, prefabricated central-station air-conditioning plants have been used to distribute air at high velocity to all the public rooms, passenger and crew accommodation. The plants are equipped with a special damper which automatically adjusts the mixture of outside air and conditioned air to economize on refrigeration. To maintain clean plant rooms and ensure comfortable working conditions in plant rooms all the year round the F.A. supply is ducted directly to all the central station plants for air mixing and an automatically operated steam preheater is fitted at the air entry. The cooling coils in the plants will be circulated with warm water to temper the outside F.A. passing through the plant in winter conditions. To facilitate maintenance, the cooling coils have been standardized in three sizes, and the plant is designed so that only a small withdrawal space is required for cooler or heating coil removal.

All first class, tourist class and senior officers' cabins have been fitted with "Marinair" constant volume room reheaters providing individual automatic control of temperature. The reheater is automatically controlled by a room thermostat which operates an insulated sliding "glove" over the hot water coil in the unit, thus adjusting the room temperature without the use of modulating water valves. The working part of the unit is hinged for easy inspection and is intended to be interchangeable for maintenance. These are entirely novel features.



Carrier air-conditioning central station unit.

On this vessel the promenade is enclosed, and is provided with partial cooling in summer and heating in winter for added comfort.

The entire air-conditioning system on the ship is controlled pneumatically. Only two types of thermostat are used having interchangeable working parts, the RMR room thermostat, a simple, robust but sensitive unit for cabins and public rooms, and the DRM duct thermostat fitted in the ducting at

each central station plant. Pneumatic control is applied to the automatic mixing damper at each central station plant.

To compensate for the variation in weather conditions at different latitudes and to take care of the cyclic internal load variations, the ship is provided with an automatic diversity control system. This system is synchronized with the ship's chronometer and minimizes refrigeration and heating requirements at "off-peak" periods. Two 400 h.p. electrically driven "Carrier" centrifugal refrigeration compressors are installed to provide the chilled water needed for the air-conditioning plants.

For even distribution of air in the cabin accommodation, constant volume slotted grilles of the directional type are fitted. The temperature in all the public rooms is thermostatically controlled and the air is distributed through continuous perforated outlet grilles. The outlets in the crew accommodation are arranged for volume control.

In addition to the air-conditioning equipment in the public rooms and accommodation there are eight heated supply plants serving the laundry, baggage rooms, store rooms etc., nine supply fan units, nine contaminated air exhaust fans and fourteen other exhaust fans. Galley dependencies are provided with "comfort" air from the restaurants and a spot cooler is fitted in the confectioner's workshop.

Extensive use is made throughout the ship of spiral wound circular conduit which greatly reduces the space required overhead and the weight and area of insulation required for the ducting.

The three cargo spaces (19,420 c.ft.) and the ten provision chambers (19,625 c.ft.) are situated on "E" deck with the refrigerating machinery arranged on the tank top to starboard.

For maintaining the required temperatures in these spaces J. & E. Hall's have supplied three six-cylinder veebloc compressors each driven by a 67.5 h.p. motor, two of which are capable of carrying out the specified duties leaving the third as a standby.

The plant is designed for hand control of the compressor and brine pump operation and also for hand control of the cargo space air circulating fans. Provision chamber air circulating fans will operate in conjunction with thermostats. The refrigerant system is arranged for automatic operation. Hot brine is circulated for defrosting purposes.

Cooling is effected in all spaces by air circulation using axial flow air circulating fans with two-pass or cross grid coolers.

The plant also provides cold brine for two 100-gallon drinking water coolers, milk-making machine and twenty-three brine cooled cold cupboards.

To maintain a minimum temperature of $-10°$ F. in a low temperature chamber of about 2,100 c.ft. capacity Hall's have supplied one six cylinder compressor driven by a 6 h.p. motor; this is a direct expansion system with a brine cooled condenser—brine being provided from the main plant.

Insulation of the cold rooms and cargo space was undertaken by J. D. Insulating Co. Ltd.

A New Refrigeration and Cold Store at the Italian Port of La Spezia

LA SPEZIA is in Northern Italy, at the foot of the Apennines, and is one of the most important ports in the country, besides having extensive textile and metal industries.

Large quantities of coal and fuel oil are reloaded in the harbour, and of course the lively trade in these cargoes has brought other commodity groups to La Spezia. Thus, the quantities of frozen and cooled foods reloaded in the harbour are constantly increasing.

Through the erection of a very modern cold store, the necessary conditions have been provided for a continued development of these important transportation operations. In this cold store, frozen goods can be stored for long periods, and fruit and vegetables can be kept in cool storage. As this plant contains several interesting items a more detailed description is called for.

The total storage capacity of the cold store, which is situated near the free port area, is 106,000 cu. ft. arranged in a total of six storage rooms, three of which hold 23,000 cu. ft. each, and the other three hold 12,333 cu. ft. each.

In these six storage rooms the temperatures can be varied according to demand, so that it is possible to keep frozen goods at approximately $-0.4°$ F. and cooled-down goods at between $+32°$ F. and $+39.2°$ F.

The plant is so designed as to work at different evaporating temperatures simultaneously, according to the current demand.

The refrigerating plant, which is supplied by "Termomeccanica" of La Spezia*, operates with ammonia direct expansion in the evaporators and is supplied with two V-belt driven V-shaped compressors, each with a capacity of 125,000 kg.cal./h. at $+14°/+7°/+59°$ F. The compressors are connected up through oil separators to a mutual multi-tube condenser which is so made as to be resistant to sea-water, since cooling water is pumped by centrifugal pumps from the harbour basin through the condenser tubes.

Steel pipes for the safety cut-outs are connected to each of the oil separators. By being connected in this way the safety cut-out is not exposed to injurious pressure impulses from the compressor piston strokes, the oil separators acting here as air vessels.

All the evaporators are made for forced air circulation and are fitted in the ante-room outside the individual storage rooms.

* All the automatic control equipment was supplied by Danfoss of Denmark.

Each refrigerating unit is supplied with a built-on ventilator and the necessary controls which ensure the retention of the desired temperature and degree of moisture in the room in question.

Each of the evaporator sections for the three big rooms is divided into two equal sections, each with its own thermostatic expansion valve, type TVAE, with external pressure equalizing. A branch pipe is mounted immediately after each expansion valve, and in each of the branches discharge nozzles with different diameters are fitted so that expanded ammonia can be led through a large or a small discharge nozzle, depending on the load on the evaporator in question, so that more or less capacity is obtained. This regulating operation is done manually by opening or closing, respectively, the shut-off valves after the discharge nozzles.

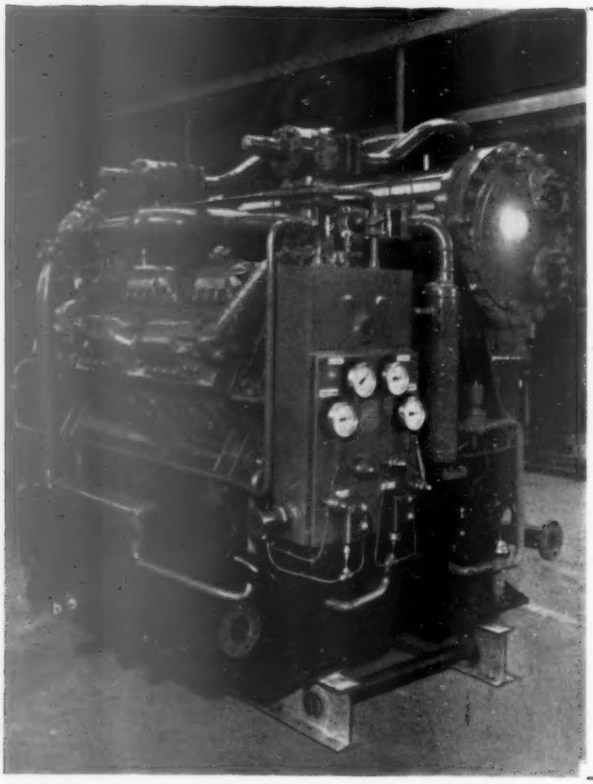
Large tubular air ducts lead the cool air from the evaporator into the storage rooms, and by means of adjustable dampers in the air ducts it is possible to obtain a uniform distribution of air and, thereby, a uniform temperature throughout the rooms.

The room temperatures are controlled by room thermostats which provide the impulses to the solenoid valve, type EVSA, which is mounted in the liquid line for the thermostatic expansion valves.

From each evaporator, two separate suction lines lead to the compressors, so that one of the compressors may—if desired—work with high evaporating temperatures and the other with low.

In the suction line normally used, a liquid separator is mounted just before the compressor. If in unfortunate circumstances during a standstill the refrigerant should happen to fill an evaporator, so that there is a risk that at the moment of starting up the plant the refrigerant is led through the suction lines to the compressors, where it could give rise to injurious liquid knocks, a liquid separator achieves safety effectively. In comparison with the total value of the refrigerating plant and the cold store, the liquid separator entails very little extra expenditure, and it should be recommended in plants with different evaporator groups and evaporating temperatures.

From the compressors, the hot gas may be taken through a coil in the bottom of the liquid separator, so that an effective heat exchange between cold and hot vapours is obtained together with refrigerant evaporation, if any.



WATER CHILLING PLANT FOR ATOMIC SUBMARINE PROTOTYPE

Water chilling equipment with a capacity of 720,000 B.t.u. per hour has been supplied by York Shipley Ltd., North Circular Road, London, N.W.2., as part of the air-conditioning scheme for the British, land-based, atomic submarine prototype at Dounreay. The plant is completely packaged, and comprises a York semi-hermetic dry-sump VW compressor shell and tube condenser and water cooler of the dry expansion type. The evaporators are a special feature, forming the base section of the unit. The total evaporator surface is arranged in four sections, water flow being passed in series over each. The unit incorporates partial capacity control down to a minimum of approximately 25 per cent. of full load.

ENTREPÔT COOL STORAGE OF FRUIT, VEGETABLES, AND CUT FLOWERS*

By J. C. FIDLER and J. R. H. NASH-WORTHAM

Agricultural Research Council; Covent Garden Laboratory, London; and Ditton Laboratory, Larkfield, Maidstone, Kent.

Introduction

MANY retail shops, as well as wholesale merchants, have refrigerated stores in which produce is held for short periods. This paper outlines the optimum conditions for short-term storage of the more perishable fruits and vegetables, and also gives some guidance on storage of cut flowers.

Storage in the market, whether wholesale or retail, differs from storage on the farm. The grower can put his produce straight into store after harvest at the precise temperature most suitable for it. The seller is handling home-grown material which was harvested at least one, and often several, days before he received it, or imported goods which may already have been under refrigeration for many weeks. He is unaware of how much of the potential storage life of the produce has been lost before he received it. Further, he has to handle a wide variety of goods, and will therefore have to use conditions which are a compromise, giving acceptable out-turn of all the different types.

It has been assumed that entrepôt storage, or short-term storage in the market, covers a period ranging from four to ten days, and that long-term storage, which is the legitimate function of the larger cool stores, will not be undertaken.†

The information given has been verified, in most instances, by controlled tests carried out in the Covent Garden Laboratory; the results are largely in agreement with data given in the list of reliable publications given as an appendix.

1. *The Specification for the Cool Store*

It is not possible precisely to specify a cool store which will be universally satisfactory. Considering size alone, this will depend on the estimated need for storage space, the space available inside existing premises, and capital available for erection and maintenance.

Different kinds of produce give off heat at different rates; some produce relatively large amounts of heat. Thus, in asking for quotations for a store, traders should specify how much produce the store will be expected to hold, how much, and of what kind, will be loaded in a day, as well as details of the site where the store is to be erected.

The machinery must be capable of cooling a day's loading of produce from atmospheric temperature to the temperature of storage in 24 hours, and must automatically maintain the desired temperature. It must do this without removal of an excessive amount of moisure from the air; vegetable produce needs at least 85 per cent. relative humidity, and preferably higher. This means that the insulation must be adequate, the cooler surface must be large, that it should all be operative, and that the temperature of evaporation of the refrigerant should be as close as possible to that of the air in the store.

Because the temperature must be uniform in all parts of the store, an efficient system of air distribution should be installed.

2 *Conditions of Storage*

A large establishment, handling a wide range of goods, will need two constant temperature rooms. These should be run at 32-34° F., and at 40-45° F. It is probable that the lower temperature room will need to have twice the capacity of the room at 40-45° F.

If only one room can be installed, it will be found most useful to keep this at 32-34° F.

As indicated above, excessive quantities of produce must not be loaded into store on the same day. Further, the produce must be stacked so that the cooling air can reach all parts of the stack.

Above all, store only sound produce. If the sample is showing wastage—rotting, over-ripe, yellowing of leaves of green vegetables—storage will only increase the amount of waste.

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* This publication replaces Food Investigation leaflet No. 9, "Entrepôt cool storage of fruit and vegetables" (now out of print).

† Advice on long-term storage conditions may be obtained from the Director, Ditton Laboratory, Larkfield, Kent (Tel. West Malling 3441) or the Officer-in-Charge, Covent Garden Laboratory, Inveresk House, 346 Strand, London, W.C.2. (Tel. TEMple Bar 6156).

TABLE I

PRODUCE WHICH MAY BE STORED AT 32° TO 34° F.

Crop	Period of storage days	Notes
A. VEGETABLES		
Artichokes (Globe) ...	10	
Asparagus	4	
Beans, Broad	10	
,, French ...	4	
Cauliflower	10	Curds should not be exposed to dirt or excessive humidity.
Celery	10	Should not be washed before storage.
Green Vegetables		
Incl. : Sprouting Broccoli, Brussels sprouts, Cabbage	10	
Leek	10	
Mushroom	4	Condensation on removal from store may cause damage.
Onion	10	Should not be kept in conditions of high humidity.
,, (spring) ...	4	
Pea (in pod)	4	
Potato (new)	10	Store in darkness to avoid "greening."
Rhubarb (forced) ...	4	
Radish	10	
Root Vegetables		
Incl. : Beet, Carrots, Kohlrabi, Parsnip, Swede, Turnip ...	10	
Salad Crops		
Incl. : Cooked Beetroot, Chicory, Endive, Lettuce, Watercress	4	Keep humidity high to prevent wilting—sprinkle green crops with crushed ice.
Sweet Corn	4	Very subject to shrivelling of the immature grain.
B. FRUIT		
Apples—American and Australian (not English)	10	
Fig (fresh)	10	
Gooseberry	10	
Grapes...	10	
Litchi	10	
Pears	10	Do not cold store early varieties, such as Williams, if turning yellow.
Quince	10	
Soft Fruits		
Blackberry and Loganberry	4	Condensation on removal from store encourages mould growth.
Currants—Black	4	
,, Red		
,, White		
Raspberry ...	-	Should not be cold stored.
Strawberry ...		
Stone Fruits		
Apricot	4	
Cherry	10	Samples with cracked or wet fruit should not be stored because of spread of brown rot.
Nectarine	10	
Peach (white flesh) ...	10	Yellow fleshed peaches should not be cold stored.
Plum	10	

TABLE II

PRODUCE WHICH MAY BE STORED AT 40° TO 45° F.

Crop	Period of storage days	Notes
B. FRUIT		
Apples (English) ...	At least 10	
Citrus		
Grapefruit, Lime ... Mandarin, Orange but *excluding Lemon*	10	(Lemons should not be stored below 50° F.)
Cranberry ...	10	
Ripe Pineapple ...	10	*Green* fruit should not be stored below 50° F.

TABLE III

PRODUCE WHICH SHOULD NOT BE COLD STORED, BECAUSE OF LIABILITY TO INJURY AT TEMPERATURES BELOW 50° F.

Type of produce	Notes (effect of cold storage)
A. VEGETABLES	
Aubergine	Sunken depressions in skin.
Peppers (green) ...	
Cucumbers	
Tomatoes	Green fruit do not ripen to good quality if stored below 50° F., and ripe fruit will rot excessively after storage.
B. FRUIT	
Most tropical Fruits: *e.g.* Avocado Pear	Suffer deterioration below 50° F. Darkening of flesh.
Bananas	Lack yellow colour and remain greyish due to browning of vascular tissue : Minimum temperature 54° F.
Lemons	Brown flecks in rind and between sections. Translucence of skin.
Mango	Sunken depressions develop in skin.
Green Pineapple ...	Colour remains grey and dull on subsequent ripening.

TABLE IV

FLOWERS—STORAGE WITH BASE OF STEMS STANDING IN WATER. PERIOD TWO TO FOUR DAYS

Variety	Temperature, ° F.	Notes
C.		
Anemones ...	Storage not recommended	Fail to draw water.
Arum lilies ...	32	
Asters, Chinese	32	
Carnations ...	32	Very susceptible to damage from volatiles given off by fruit.
Chrysanthemum ...	32	
Dahlias ...	32	Do not store longer than two days.
Gladioli ...	32	
Iris (Imperator)	32	
Narcissus ...	32	Very susceptible to damage from volatiles given off by fruit.
Roses ...	32	
Tulips ...	40–45	Chilling injury on foliage if stored at 32° F.

NOTE.—It is not advisable to store fruit and flowers in the same store. Those flowers particularly susceptible to injury are noted in the table.

It will not be found that tainting of one kind of produce by another is serious. In our experience, cross-tainting is only serious when " Earthy " types of vegetables are stored in any quantity, or when rotting produce is left in store.

The rooms will, of course, be of most use in warm weather. This means that the goods taken out of store will be much colder than the outside air, and moisture will condense on them. For most kinds of produce, this does not matter, but it is important, and can be dangerous, with soft fruits and berries. If the store can be fitted with an air lock, in which the goods can be left for a while, the temperature transition will not be so abrupt, and condensation will be reduced.

A. *Fruits and Vegetables*

The tables above list the kinds of produce which may be kept at 32-34° F., and those which need to be higher, at 40-45° F., and also indicate whether they should be kept for 4 days only (*i.e.* over a long week-end), or may be kept for 10 days. Additional notes show special conditions to be applied to some sorts of produce. Table 3 lists the varieties which should never be cold stored.

B. *Cut Flowers*

It has been found that the optimum conditions of storage of cut flowers which have passed through the wholesale market often differ from those recommended for freshly cut flowers. Many freshly cut flowers keep best if stored dry, or wrapped in polyethylene, but flowers as received by the retailer keep best with the base of the stems standing in water.

Many kinds of flowers are damaged by volatile substances given off by ripe fruits, or by slight leaks of coal gas; this damage is not serious at 32° F., but can be very rapid above 40° F.

While most important kinds of produce have been dealt with above, no doubt the owner of a cool store will indulge in a certain amount of experimentation; this will yield much valuable information, but if full notes are kept it should be borne in mind that fruits and vegetables often develop defects in cold storage which are not immediately obvious on removal from store, but only appear after the lapse of some time at ordinary temperatures. Thus the experiments should include storing the material at ordinary temperatures, after cool storage, for about the length of time it would normally take for it to reach the consumer.

The Covent Garden Laboratory exists to help the fruit and vegetable trade, and in return receives much help from the trade. The officer-in-charge will be glad to hear the results of any trials carried out in this way, or to give assistance wherever possible. The address is Inveresk House, 346, Strand, London, W.C.2. All communications should be addressed to the officer-in-charge.

(1) " Recommended conditions for cold storge of perishable foodstuffs " (1959). International Institute of Refrigeration, 177 Boulevard Malesherbes, Paris, 17. 7.N Francs.

(2) " The commercial storage of fruits, vegetables and florists and nursery stocks." Agric. Handbook 66. U.S. Dept. of Agriculture, (1954), U.S. Govt. Printing Office, Washington, 25, D.C., U.S.A. 30 cents.

(3) " Recommendations for the transport of perishable foodstuffs." Bulletin of the International Institute of Refrigeration, 1955, Vol. 35, No. 3., pp. 606 to 633.

ICE FLAKES AND ELECTRO-SHOPS AT THE SELF SERVICE, VENDERS AND SHOP DISPLAY EXHIBITION, OLYMPIA, MAY 15th to 19th, 1961

WHEN the exhibition opens at Olympia on May 15th, there will be scores of innovations to interest everyone connected with the retail trade from the executive of the largest supermarket to the owner of the little shop around the corner. The exhibits will range from huge refrigerated display cases ; weighing machines ; pre-packing machines ; shelving ; price labelling machines ; cash registers ; stock registers ; stock control charts ; self service baskets ; trolleys ; display stands ; automatic vending machines in fact everything that goes to making the shop, self service store or supermarket more efficient, colourful and streamlined.

Great advances have been made of late in the automatic vending field, and the newest is the " Electro-shop 24," designed to take care of that blank spot between closing and opening time, and means that one is doing business all around the clock. It is being shown by **Electro-shops Ltd.**, the associate company of Rotiss-o-Mat Ltd. It is capable of selling 24 different lines of goods at normal or refrigerated temperature and its special feature is that one does not have to tender the correct amount of change, for there is a built-in electric automatic change-giver. The procedure is that coins are inserted and as they go in, the amount tendered is automatically shown on a panel and then the buttons are pressed in front of the goods required. As each button is pressed, the goods which are housed on a moving belt system behind the scenes appear almost immediately in a wire basket attached to the front of the " shop " and at the same time as the credit balance changes with each purchase, it is indicated on the panel. All that has to be done to collect the change, if any, is to press the change button and it appears, including only the minimum amount of coppers; the rest is in silver. The shops are 2 ft. 6 in. wide, 8 ft. in depth and 6 ft. high. They can be supplied in any colour, and are particularly suited apart from shop use, for railway stations, bus stations, canteens, etc.

Rotiss-O-Mat will also be showing their latest infra-red baking equipment—" the bake-o-mat "—as well as their three commercial barbecue machines. Ice flakes for preventing fish, meat, poultry and many other food stuffs drying out while on display, will be demonstrated by **M. L. Winsor & Co. Ltd.**, in the " Scotsman Automatic Ice Flake Machine." It comprises a refrigerated cylinder into which water is automatically pumped, the result being that ice forms on the sides of the cylinder. Inside the cylinder is an auger, which as it rotates scrapes the ice off the sides and automatically pushes them up into a refrig-

(*Continued on page* 498)

Innovations in Capillary Tube Dynamics

SPECIAL REPORT ON LATEST U.S. FINDINGS

By E. W. Zearfoss, Jnr.

* The present concepts, applicable to refrigerating systems, originated from studies made on the expansion process in capillary tubes during non adiabatic flow. This work suggested that unique flow control dynamics might be realised through the introduction of simple innovations to conventional capillary tube circuitry. Significantly, the resultant system modulates refrigerant flow to the evaporator in direct response to suction line superheat. In addition, this capillary system exhibits other interesting performance characteristics. Basic theory, design parameters, engineering features and experimental data supporting these derivations are included in the article. The background material affords a qualitative refresher course on conventional capillary tube performance.

Introduction

EVERY year millions of capillary tube controlled refrigerating systems are manufactured by the industry. This design was once limited almost exclusively to fractional horsepower machines, yet today capillary tube adaptations to integral horsepower units represent a good percentage of the market total. Many ingenious designs for system components have made this success possible and efforts toward advancing the scope and performance of capillary tube systems continue. Control of refrigerant flow in any heat cycle is an important area for study, since optimum efficiency depends upon well co-ordinated thermal processes. The present contribution to capillary tube dynamics originated with this quest for better flow control.

Capillary tubes in a conventional system merely meter the refrigerant medium from the condenser to the evaporator. The system flow characteristics are determined basically by the capillary tube physical dimensions as related to the sizing and performance of other circuit components. Optimum balance between refrigerant mass flow in the tube and system capacity exists as a mere line function of operating conditions, although deviations from ideal noted over the entire operating band obviously have not precluded broad acceptance of the capillary tube.

Another potential dimension or element in capillary system flow control, apart from the forgoing expansion function *per se*, involves a control mode responsive to evaporator thermal demands. Thermostatic control of this sort is exhibited by the remote sensing element in a mechanical expansion valve which translates evaporator loading (reflected by suction line superheat) into modulated refrigerant flow. No counterpart to this exists in today's capillary flow dynamics. Instead, the capillary tube system compromises this realistic feature with an evaporator geometry (and limited refrigerant charge) designed to prevent liquid flow to the suction line. Flooded, semi-flooded and series tube evaporator with accumulator are design examples. Specifically, this paper outlines a capillary tube organization possessing a thermostatic sensor dynamically equivalent to that embodied in mechanical expansion devices.

Circuit Description and Function

The present circuit is rather simple, as figure 1 depicts. Here, a compressor, condenser, capillary tube, evaporator, and suction line are series connected and the capillary tube and suction line arranged in thermal exchange. Departure from normal circuitry resides in an accumulator having two outflow restrictors interposed, the capillary tube and the evaporator inlet, and a second capillary portion in heat exchange with the suction line.

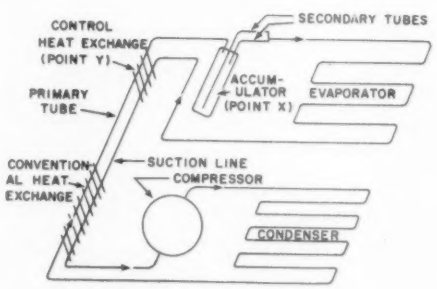


Fig. 1.—Schematic circuit.

SPECIFICATIONS

Compressor	1/5 hp. 1-1/8 b x 7/8 s	Evaporator	65 feet *
Condenser	12 pass tube & plate	Suction Line	5/16 od.
Primary Tube	100 inches 031 id.	Refrigerant	10 oz. R-12
Secondary Tubes	30 inches 042 id.	Heat Exchange Y	8 in. soft solder
Accumulator	1-1/4 od. x 9 inches	Conv. Heat Exchange	40 in. soft solder

* 30 feet 5/16 od. & 35 feet 3/8 od. in series

Functioning of the subject circuit can also be described simply. The capillary tube delivers a mixture of gaseous and liquid refrigerant to the accumulator. Gravity

separates this mixture, so that gas and liquid flow to the upper and lower restrictors respectively. Then, suppose an accumulator momentarily half full of liquid, and suppose further that refrigerant overflows from the evaporator to the suction line side of the control heat exchange (see figure 1). This liquid at the control heat exchange causes heat to be rejected from the capillary tube and thus decreases the gas to liquid ratio of refrigerant entering the accumulator. Accordingly, the original mass flow vs. pressure balance across the two restrictors is disturbed, causing the accumulator liquid level to increase. This change occurs at the expense of mass flow to the evaporator, and subsequently to the suction line. Figure 2 shows this graphically.

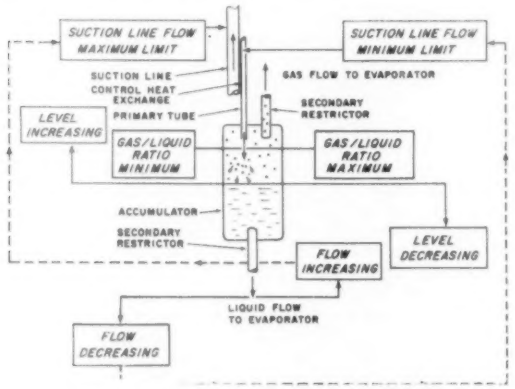


Fig. 2.—A simplified flow control diagram.

The resultant decrease in thermal transfer at the control heat exchange increases the gas to liquid ratio in refrigerant delivered to the accumulator. Flow vs. pressure balance across the two restrictors again is disturbed, but this time in the opposite direction, causing the accumulator liquid level to decrease. Increased mass flow to the evaporator and suction line naturally follows and the described modulation pattern repeats. Again see figure 2. This cyclic mode or complex comprises the essential flow dynamics of the system. Further comment appears in the "Circuit Analysis" section of this paper.

Experimental System

The unit specifications marked on figure 1 evolved from experimentation which fully corroborated the theoretical concepts. This system was tested through a range of suction temperatures (+25° to −20° F.) and discharge temperatures (110° to 170° F.). Electrical heaters provided supplemental evaporator loading. The characteristic curve of figure 3 was derived from the steady state data recorded on this unit. The cyclic flow control pattern exhibited a time constant of two to three minutes with suction temperature variations of approximately one to two degrees Fahrenheit.

Figure 3 shows how refrigerant liquid from the evaporator modulates quantitatively in the suction line for given suction temperatures. From the foregoing section on circuit function it will be noted that accumulator outflow vs. evaporator or actual (suction temperature) flow, must be out of phase. An instance of this mutual interaction, which really defines the basic flow control concept, appears graphically in figure 3. Here, a typical steady state suction temperature flow line and an accumulator mass flow line intersect, to provide this phasing. For any given suction temperature norm, corresponding suction temperature flow and accumulator flow deviation lines exist in a comparable relationship.

Figure 3 shows another characteristic of the general system. With decreasing suction temperatures (and mass flow) an increasing portion of the control heat exchange works at saturation temperature. This is ascribed to an increasing gaseous component in the capillary and, therefore, increased heat transfer to the suction line is necessary to achieve modulation dynamics.

Moderate evaporator superheat and suction line overflow were observed only during inordinate load transients created by energizing or de-energizing the electrical heater respectively. Here, the suction temperature was modified 20° or 30° in a matter of several minutes, so that some deviation from ideal control was to be expected.

The secondary restrictors used in these tests have equivalents in other bores (and lengths). In a preferred embodiment, dissimilar secondary tubes like a 0·090 bore and a 0·031 bore (0·081 od.) can be telescoped in appropriate geometrys, with the annular space providing the gas passage and the 0·031 bore (extended from the lower region of the accumulator) providing the liquid passage.

Engineering Features

The present capillary tube circuit integrating a suction line thermal sensor with contemporary tube metering function as described above, has many engineering features.

1. Maximum Load Response :

   Conventional capillary tube systems using a series evaporator (with accumulator) have refrigerant liquid stored in the accumulator at the end of an operating cycle. There is no positive means for displacing this refrigerant on the subsequent run cycle. An inordinate period is needed, therefore, to rebalance flow to the entire evaporator. The instant circuit poses no such problem. To illustrate this comparison, figure 8 shows performance curves, during cyclic operation, for a conventional series evaporator with accumulator and the present circuit. The refrigerant distribution curve of the standard circuit produces a suction temperature (at saturation) curve suggesting low system efficiency (since thermal capacity is directly related to mean suction temperature). By contrast, high refrigerant charge mobility in the present circuit keeps flow distribution and suction temperature curves at correspondingly high

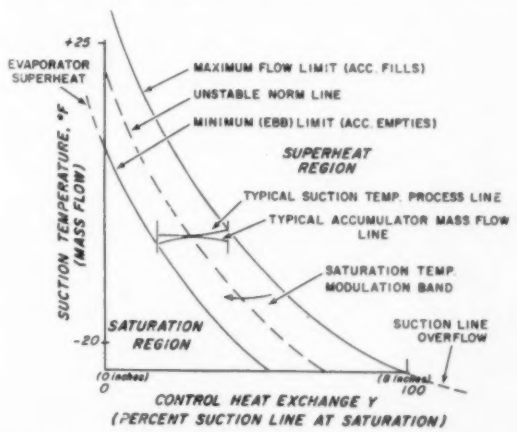


Fig. 3.—Characteristic curve—heat exchange modulation vs. suction temperature.

levels. Note that the standard operating cycle must be of greater duration to develop a total capacity equivalent to that afforded by the present concept. Response to transient loads or mid cycle "peaks," follows comparable patterns for the respective systems.

A similar case in point might be made for some items listed below.

2. Minimum Refrigerant Charge :

Since the proposed circuit keeps liquid active and responsive to load demands, a lesser refrigerant charge will produce results equivalent to those demonstrated by a conventional evaporator and accumulator arrangement.

3. No Oil Logging Problems :

This is an obvious yet important point and again a direct result of accumulator orientation in the circuit.

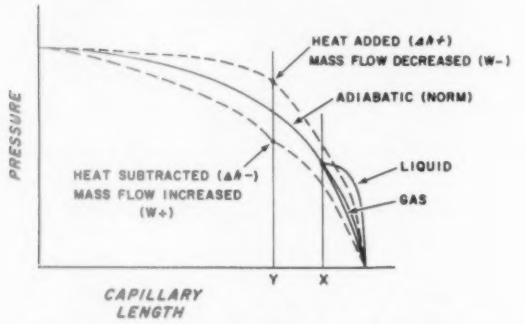


Fig. 4.—Characteristic capillary tube curve on pressure vs. length coordinates.

4. Minimum Peak (Pulldown) Load :

This favourable characteristic is a function of refrigerant quantity in the system and hence explained by item 2 above. Then too, secondary restrictor sizing can influence this point. See section entitled "An Actual System." It follows that in some instances a compressor motor with a lower horsepower rating can be used when compared to a conventional system, since a more proportionate pulldown vs. normal loading is realised.

5. Maximum Evaporator Performance (Low Superheat) :

A review of the foregoing text will explain the dynamics of this basic feature. Of course, this accounts for the feature described under Item 1 above, and in the present context, includes continuous operation as well as cyclic performance.

6. Defrost Cycle Operation :

A valve controlled conduit extending from condenser to evaporator inlet adapts the basic circuit to "hot gas" defrosting and produces a dynamically modulated defrost cycle with moderate performance characteristics. The defrost cycle "time constant" can be decreased by arranging the hot gas line and accumulator in heat exchange relationship.

7. Compactness :

Conventional accumulator size is determined by the refrigerant charge in the system plus the displacement effect of suction gas bubbling or flowing there through. In the present system, accumulator volume is not "lost" by the passage of suction gas. This, coupled with an initial charge of lesser value, affords considerable accumulator size reduction.

8. Simplicity :

The strainer/drier can be incorporated into the accumulator volume, thus obviating a separate component. Compactness is implied here too. Further, telescoping the secondary tubes, keeps the number of solder joints equivalent to those in a conventional unit. When the capillary tube, accumulator and secondary restrictors are designed as a "sub package," the final unit assembly is further simplified.

Design Application

Application to a given system can be realized easily from the deductive viewpoint : Keep the existing primary tube intact, and select secondary restrictors each of restrictive or impedance value equivalent to 5 or 10 per cent of the primary tube value. Converting the secondary restrictors to a bore larger than the primary tube will avoid critically short tube lengths. Next, insert a non-restrictive tube in the circuit between primary tube and accumulator volume and solder the suction line thereto for a length of 8 to 12 inches thereby making a control heat exchange. This latter expedient allows original primary tube performance to be approximated.

Actual under or over control, *i.e.* failure to realize a frost point at the heat exchange or one beyond the heat exchange respectively, will now be a function of suction temperature (mass flow) and secondary tube restriction. Usually, shortening either the secondary liquid tube if the suction temperature vs. control response band is to be

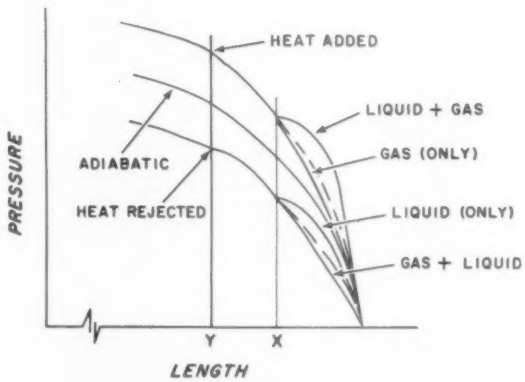


Fig. 5.—Capillary tube point X phase distortion vs. point Y enthalpy differentials on pressure vs. length coordinates.

decreased or shortening the secondary gas restrictor if the band is to be increased will correct original deviations from desired control. Subsequently, the suction line is heat exchanged with the primary tube and the non-restrictive tube discarded. In the latter instance, the performance of the primary tube is modified somewhat. Keeping the heat exchange toward the outlet end of the primary tube will minimize this effect, and only in certain applications will the secondary tubes reflect this change.

A question might arise here as to the total impedance of the network described above, since secondary restrictors were added to the original primary tube. While this is true, the new control heat exchange introduces a compensating factor by decreasing primary tube effective

impedance. In any event, when an observable negative has crept into overall performance the primary tube can be modified accordingly.

Note that any conventional suction line/capillary tube heat exchange can remain intact when converting a unit as described above. This heat exchange must be upstream on the primary tube and downstream on the suction line with respect to the " control heat exchange " length Y.

The subject flow control organization is applicable to any unit within the scope of capillary tube design parameters. The evaporator is preferably of the series tube variety. *In the integral hp sizes the primary/secondary tube network for flow control can be paralleled with a conventional tube designed to handle the bulk of the mass flow.* This pilot type control circuitry has less thermal inertia and the response accordingly is more sensitive.

Certain design simplifications are possible with the accumulator and secondary restrictor elements. One, the accumulator may be adapted to contain the desiccant for the system and two, the secondary restrictors can be telescoped or nested. These arrangements obviate a separate drier component and several soldered tube connections.

CIRCUIT ANALYSIS

1. Fundamentals

Conventional tube dynamics (assuming sub critical flow) introduce the present concept. Saturated liquid medium entering a capillary tube is subjected to flow impedance and a consequent decrease in pressure. The flash gas evolvement, inherent in this state point change, creates flow factors that progressively increase with passage through the tube. Hence, the typical capillary tube curve (tube length vs. pressure) of figure 4 is ascribed to a " snowballing " gaseous component, with density, mass and velocity factors operating. Note that the final gaseous component usually represents but a fraction of tube mass flow and thermal capacity, while however dominating total flow and tube performance. Moderate

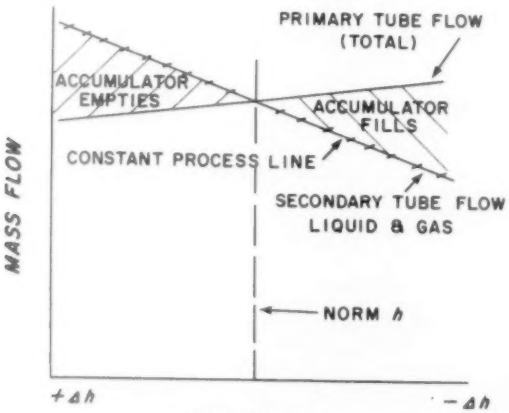


Fig. 6.—Point X total flow vs. point Y enthalpy deviations with accumulator at point X.

enthalpy deviations performed on the tube medium will have significant influence upon the gas component, flow character and capacity of the tube. The mass flow affects of a given thermal deviation are at a maximum when applied to the tube inlet.

Adiabatic flow through above described tube is a function of inlet and outlet state points and tube geometry. Departures from the adiabatic parameter produce gaseous component differentials and corresponding mass flow affects. Adding heat to the tube medium will decrease the mass flow rate and subtracting heat from the tube will increase the flow rate. The dotted curves in figure 4 show this relationship. Note that a discontinuity in the curve attends flow subjected to a non-adiabatic process of this sort. All contemporary suction line/capillary tube heat exchanges produce this effect.

Next, consider explicit division of liquid and gaseous phases in the tube at an arbitrary point X, (figure 4) and the downstream tube portion replaced by an equivalent network of two secondary restrictors. Total tube dynamics are unchanged but liquid and gas flow separately through the respective restrictors. Quite expectedly, the primary tube/secondary restrictor combination responds to non-adiabatic deviations in a manner similar to the original single tube.

Heat added at point Y again causes decreased mass flow in the primary tube, and an upward divergence of point X, but an inexact phase flow through the secondary tubes supersedes the original separation of the liquid and gaseous components. Thus, while gas exclusively flows through the gas restrictor, liquid plus a gaseous increment now enters the liquid restrictor. This is shown graphically in figure 5.

When heat is rejected from point Y the increased mass flow in the primary tube and downward movement of

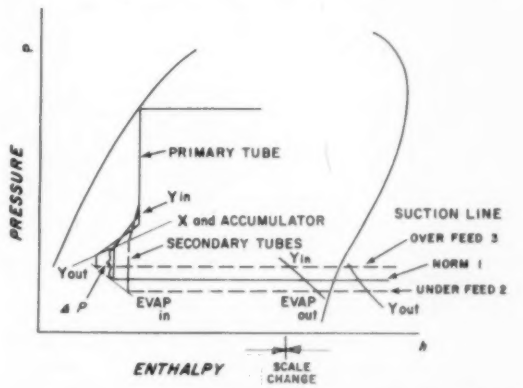


Fig. 7.—Flow control dynamics on pressure enthalpy coordinates.

point X, creates the opposite phase unbalance. Liquid only flows to the liquid restrictor, while gas plus a liquid increment finds passage through the gas restrictor. Again, see figure 5.

Note that in an actual circuit the point Y thermal processes occur between capillary tube and suction line, and for the capillary to absorb heat from the suction line, evaporator superheat must exist. Since this implies decreased system capacity and efficiency, cyclic heat absorption and rejection is less than ideal. *For realistic design, therefore, the analytical norm or zero point must be displaced or biased to cause heat rejection from capillary tube point Y continuously but in a modulated character.* The original tube system merely is reproportioned physically to achieve this latter objective. Hence, subsequent discussion of system dynamics will proceed on the basis of modulated heat rejection.

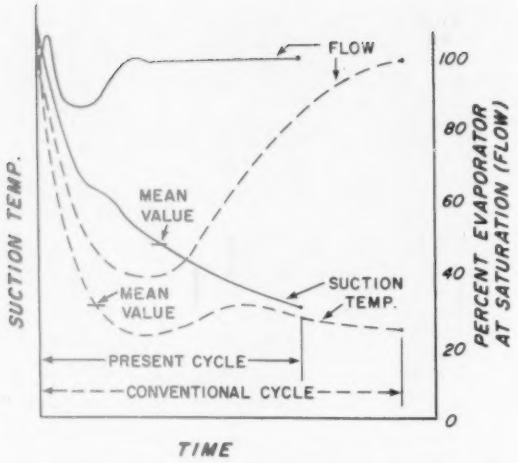


Fig. 8.—Characteristic curves—system performance on suction temperature vs. time coordinates.

2. Circuit Dynamics

The above point X secondary tube phase shifting "mechanism," attending point Y heat modulation, is adapted to flow control merely by interposing the finite (accumulator) volume at the primary tube/secondary tube junction. See figure 1. Then, the maximum heat rejection limit from point Y disposes liquid toward the gas restrictor (and increased mass flow). But, the accumulator obviously retains the displaced liquid increment during this transitory period and decreases actual secondary tube flow to the evaporator. Subsequently, minimum heat rejection at point Y disposes gaseous phase flow toward the liquid restrictor (and decreased flow) but the accumulator, by releasing the stored liquid increment, causes increased net flow to the evaporator. These eventualities are charted in figure 6. Further, figure 6 shows that the secondary restrictor net mass flow trend is opposite to the primary tube rating based, of course, on the assumption that the accumulator contains part liquid and part gas. Note, that the secondary tube net flow curve (figure 6) is proportional to the secondary delta P values (figure 4). And note, that the primary tube differential slope is minimized through having heat exchange point Y close to the point X.

The dominant fact in the foregoing is that the accumulator volume becomes an instrumentality producing a secondary tube mass flow inversion.

Since the secondary restrictors represent a small fraction of total expansion impedance, even point Y heat exchange effects of extensive character are convertible into dynamics for modulation of secondary tube mass flow, without reaction adverse to the gross expansion process. Optionally, heat exchange Y could be made directly on the accumulator but this would be less " sophisticated."

3. An Actual System

In an actual circuit, the foregoing secondary tube responses are derived from the thermal energy in the suction line (see heat exchange figure 1). Minimum suction line liquid flow, tending toward an underfed evaporator, causes the primary tube to reject minimum heat at point Y and hence initiates the increased mass flow pattern. Conversely, maximum suction line liquid flow, effected by an overfed evaporator trend, makes the primary tube reject more heat to point Y with a resultant decrease in flow toward the evaporator. These operational modes are self limiting and hence inherently cyclic. Note that mass modulation in the accumulator *per se* constitutes comprehensive flow control, since refrigerant distribution throughout the complete system is guided accordingly.

Figure 3 shows the performance of an actual system in a given ambient. Again note the flow limit curves which define the basic control modulation pattern, and that the suction temperature (for a typical process line) increases proportionately with increased control heat exchange values. This latter effect is merely an outgrowth of increased mass flow toward the compressor.

Figure 3 further shows how decreasing suction temperatures (and hence increasing gas to liquid ratios in capillary flow) result in a displacement or divergence of the flow modulation curves. The " peak " suction temperature occurs when the flow limits move into the indeterminate superheat region ouside the zero heat exchange value and of course is determined basically by primary tube/secondary tube selection. The other extreme occurs at the temperature where the suction line becomes flooded beyond the 100 per cent heat exchange value and, by definition, the system looses flow control. These terminal points are subject to broad functional tolerance and discussed primarily for their theoretical interest. However, it is possible to design a system with a " built in " suction temperature limitation for compressor load control, etc. through proper sizing of the respective secondary tubes. This latter instance may have great utility in specific problems.

Variables existing when the primary tube of figure 3 departs from ideal design conditions, *i.e.* operates over or under restricted, tend to modify the reference point upon which the foregoing norms and dynamic treatment were formulated. Here, the heat exchange datum automatically shifts quantitatively too, and inherently compensates well within the definition of successful engineering application. These affects are an integral part of the curve in figure 3 since only one point, for instance the norm at 50 per cent saturation temperature, can represent an ideal design point on the curve.

4. Summary on ph Diagram

Figure 7 affords an excellent graphical summary of the concept on the more classic ph co-ordinates. The norm process line 1 is readily traceable from the primary tube flow and the control exchange deviation points Y_{in} to Y_{out} and/or point X. Next, secondary tube flow from accumulator to evaporator is marked by a given pressure differential (delta P). The evaporator and suction line tracings follow, the latter Y_{in} to Y_{out} spanning the saturated vapour line, and being the counterpart of the primary tube deviation Y_{in} to Y_{out} noted earlier. Now this exact process or pattern is unstable and hence a drift must occur. Suppose this drift be toward the under flow shown dotted in process line 2, where the limit is exaggerated to make the differentials involved discernable. Process line 2 exhibits two important facts relative to norm line 1. One, the delta P from point X to the evaporator inlet has increased because the suction line side of control heat exchange Y tends toward starvation and two, this increased delta P is incompatible with decreased flow from the accumulator to the evaporator. Hence, the flow cycle reverses toward the norm and continues to the over flow limit of process line 3. The decreased delta P by virtue of the increased delta h involved in the primary tube/suction line heat exchange Y is again incompatible with continued mass flow at the instant value. The descriptive cycle then repeats in the modulation complex which characterizes the basic control dynamics.

New Refrigerated Van

WITH AUTOMATIC DEFROST

IN the March issue of MODERN REFRIGERATION, page 261, there was described a new refrigerated truck recently included in J. Lyons & Co.'s ice cream delivery fleet.

The progressive initiative of J. Lyons's refrigeration service in the development of continuously refrigerated vehicles is again demonstrated by the further inclusion in their local ice cream delivery fleet of 80 30-cwt. vans equipped with forced-air evaporators, and the Ranco reverse cycle defrost system providing an operative temperature of minus 5/10° F.

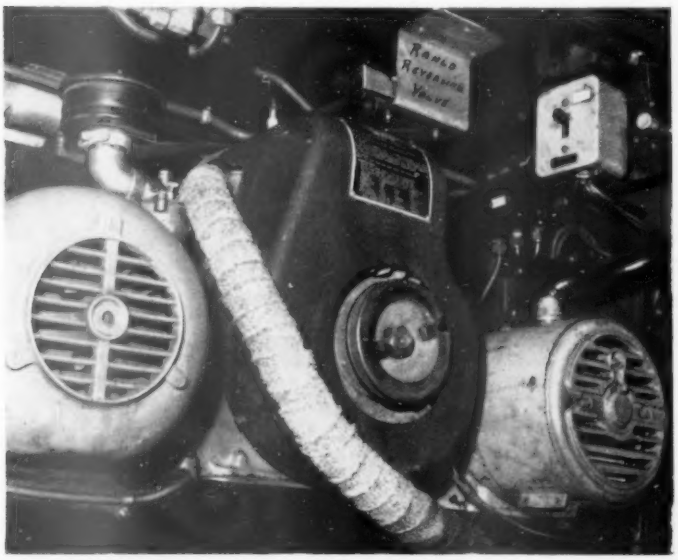
The payload in these vans compares favourably with heavier vans up to 3 tons, using other types of cooling coils, which take up considerable space, and impose an uneconomic weight load.

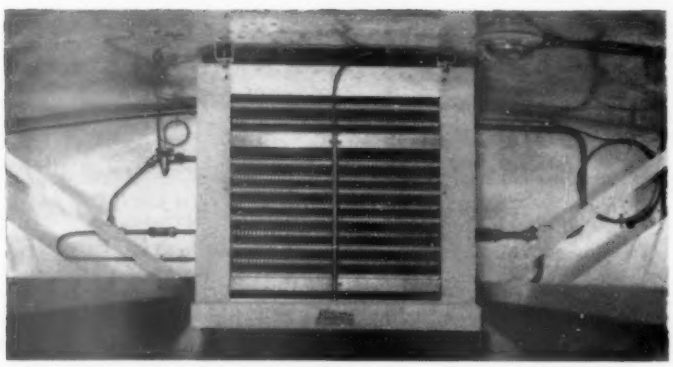
The defrost periods are determined by a Ranco E.11 timer at four-hourly periods which initiates the defrost on the time cycle and terminates an evaporator temperature, a unique feature eliminating unnecessary de-frosting time.

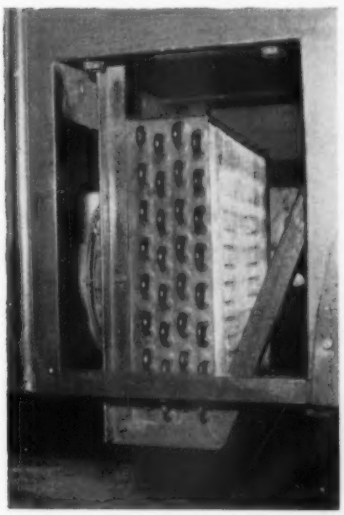
The power unit assembly is cleverly arranged to avoid taking up "payload" space with the compressor, B.S.A. engine, electric motor (for depot mains operation) and A.C. generator (to energize evaporator and condenser, fans, reversing valve and timer) mounted on the off-side underslung between wheels, whilst the air-cooled condenser and fan are mounted, again underslung, on the nearside.

The Ranco reverse cycle defrost system has been under test by J. Lyons throughout 1960 on a prototype vehicle and has successfully demonstrated that effective defrosting can be assured without temperature rise of stored products and enabling the vehicle to be in constant service, eliminating the weekly "day-off" for defrosting other types of cooling coils.

Thus J. Lyons can rightly claim to be the first in this new field of defrosting, certainly in the U.K., if not throughout the world.







Left: Refrigeration power unit.

Bottom left: The forced air evaporator.

Below: The condenser slung under the van.

New Low Temperature Cold Room in Stockport

Lovell Wall & Co. Ltd.'s installation by Refrigeration Services Ltd.

CLAIMED to be the post modern low temperature cold store in the north of England, this new installation on the premises of Lovell Wall & Co. Ltd., Reddish, Stockport, has recently been put into service.

The cold room—internal dimensions 85 ft. by 24 ft. by 13 ft. high—designed to operate at minus 10° F. for the storage of frozen food, has been constructed into a section of a disused cotton mill, the remainder of the building being utilized as a warehouse. The brick shell is insulated to walls and ceiling with 8 in. of expanded polystyrene, and the floor with 8 in. compressed slab cork. The finish to the walls and ceiling is in cement plaster with 2 in. by 2 in. dunnage battens set diagonally as a protective measure. The final finish to the floor is 2 in. granolithic concrete laid in sections with bitumastic expansion joints, protection from frost-heave being provided by a Lo-Heat anti-frost mat.

The main door is of the super-freezer type and there are also four loading plugs, all of which are equipped with anti-frost heater gaskets. The insulation work was carried out by Messrs. J. D. Insulating Co. Ltd., Liverpool.

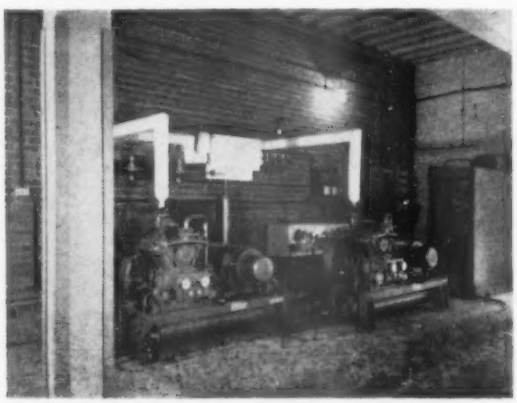
Refrigeration is by Prestcold and consists of two Prestcold model WR1000 water-cooled units with 10-h.p. slip-ring motors, water being provided by a Heenan Froude Aquatower. Cooling is by a Searle model GD400 floor-mounted unit cooler, delivering air throughout the room by means of a ceiling-mounted ducting. A unique feature of this ducting is the inclusion of Sturtevant adjustable diffusers whch give draft-free air circulation throughout the room, allowing the staff to work without discomfort. The cooler is made up of two sections each being operated by a separate condensing unit, independently controlled by its own thermostat. By placing one coil in front of the other two-stage cooling is effected, and when the room is down to temperature, should a mechanical breakdown occur one unit is capable of maintaining the desired temperature over long periods.

Defrosting is by means of hot glycol and is controlled by two time clocks which are set to operate the defrost heaters 15 minutes before the actual defrost cycle commences. This ensures that the glycol is at the right temperature and that a speedy and efficient defrost is obtained.

This cold store was designed by Refrigeration Services Ltd., 257, Stockport Road, Ashton-under-Lyne, Lancashire, who are also responsible for the installation of the Prestcold equipment.

Superfreezer door and hatch to store.

The Prestcold installation.



Resale Price

On Friday, April 14, 1961, Associated & Independent Merchandisers Ltd., trading as Grandways, submitted to a perpetual injuction in the following terms :

" that Associated & Independent Merchandisers Ltd., trading as Grandways, by their agents, servants, and otherwise, be restrained, and an injunction is hereby granted restraining them from the following acts or any of them, that is to say, reselling or offering or displaying for resale at prices other than the respective prices prescribed by Frigidaire for the resale of such goods, any Frigidaire household refrigerators or any other goods already sold or hereafter to be sold by Frigidaire subject to a condition as to the price at which they might be resold."

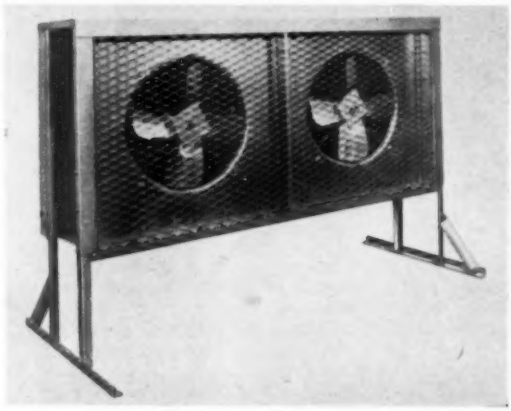
Borough Appointment

The governors of the Borough Polytechnic announce that they have appointed Mr. J. C. McVeigh, M.A., M.SC., A.M.I.MECH.E., as principal lecturer in the Department of Mechanical Engineering.

New 100 C.FT. Capacity Cabinet

Lec Refrigeration Ltd. have just introduced a self-contained cold room with the large capacity of 100 c.ft. and featuring insulation of fibreglass and cork, complete with a new vapour seal to give adequate protection against the ingress of moisture. Constructed of top quality steel, the Lec cold room has an exterior of rust-proof Zintec primed steel with a high-bake synthetic enamel finish. The interior is of galvanized zinc coated in steel specifically designed to stand up to hard wear and constant use under all conditions. Powered by a Vertimetic hermetically sealed compressor, the cold room exterior measurements are 6 ft. 6 in. high by 3 ft. 10 in. wide by 5 ft. 6 in. deep, thus providing spacious and comfortable storage.

The door is of robust construction and has been fitted with particular care, being seated on soft rubber gaskets to give a perfect airtight seal. Strong galvanized hinges and padlock-type locking handle have also been fitted. A cover-light is situated on the front wall to ensure maximum interior lighting. The Lec condensing unit comprises a well balanced, low wattage, sealed-in-steel compressor which requires no oiling, together with a balanced fan and motor cooling an ample sized condenser.



New Air-Cooled Condensers

A flexible series of air cooled condensers, which can be installed singly or in multiples, has been added to the range of equipment manufactured by **Carlyle Air-Conditioning and Refrigeration Ltd.**, London. These new air cooled condensers are available in three basic sizes 9AB6, 9AB8 and 9AB12, with capacities that range from 3 tons for air-conditioning applications. The basic assembly for the 9AB6 consists of a single direct-driven fan, a copper tube aluminium-finned coil and a galvanized steel casing. The 9AB8 and 9AB12 are correspondingly larger, each having two direct-driven fans. All three models are only 38 in. high. Full condenser capacity is utilized by the direct drive fans which can move large quantities of air evenly across the entire face of the coil. Capacity is improved by the " blow thro " design, which prevents clogging screen and coil with debris and papers. A flat metal screen at the inlet eliminates the need for a protective guard over the fans.

Wheatstone Refrigeration Co.'s stand at the Meat Machinery Exhibition in London.

New Refrigerated Vehicle with Own Generating Plant

MAKING its début at the Second International Refrigeration and Air-Conditioning Exhibition held recently at Earls Court, London, the "Polar Blast" refrigeration unit was shown in conjunction with an insulated body mounted on a 3 ton chassis cab.

This refrigerated vehicle produces sub-zero temperatures and was designed and produced by Blox Services Ltd. on behalf of Flying Goose Ltd. who are currently distributing "oven-ready" ducklings throughout the west country.

The "Polar Blast" equipment has been acclaimed as a major advance in refrigerated transport development and features many new advantages in accurate and reliable temperature control. Refrigerated forced air circulation throughout the load space means maximum efficiency in difficult and arduous working conditions. Fully automatic electrical de-frost equipment controlled on a time cycle ensures that the "Polar Blast" unit can be applied successfully to bulk transportation, inter-depot and local distribution. Increased payload over other types of equipment is brought about by lightweight constructional methods in the refrigeration unit and insulation. Temperature can be selected from –10°F. to +45°F. according to the original specification.

Built-in generating equipment supplies electrical power to the "Polar Blast" unit whilst operating on delivery work. Change-over to mains current at depot or garage can be effected simply by plugging into a power point. Food distributors can now extend their operational areas in the knowledge that Blox "Polar Blast" refrigeration equipment does not require recourse to expensive staging facilities between long hauls. Standard domestic electrical current is used throughout the system.

Blox Services Ltd. have undertaken a considerable programme of research and development in the field of temperature-controlled transport. Individual specifications are prepared only after exhaustive research into each distributor's problem. Operators are assured, therefore, of profit-earning refrigerated transport.

NEW COMPANIES

The accompanying particulars of New Companies recently registered are taken from the Daily Register compiled by Messrs. Jordan and Sons Ltd.

Coolcraft Ltd., Dickerage Lane, New Malden. To carry on business of refrigerator manufacturers and dealers, etc. Nominal capital: £5,000 in £1 shares. Director: John A. McGibbon, Little Orchard, More Lane, Esher.

Wincold Coolers Ltd. Nominal capital: £1,000 in £1 shares. To carry on business of refrigeration and cold storage engineers, etc. Directors: Henry A. Jones, 50, Cottingham Grove, Bletchley, Bucks.; Robert S. Curry Oak Cottage, Granborough, near Bletchley.

Blackpool Refrigeration Ltd., 80B, Charles Street, Blackpool. Secretary: Joan Bridge. Nominal capital: £1,000 in £1 shares. Directors: Kenneth W. Bridge and Mrs. Joan Bridge, 8, Montpelier Avenue, Bispham, Blackpool.

Lichfield Refrigeration Services Ltd., Pipe Hill House, Lichfield, Staffs. Secretary: Robt. A. Thompson. To take over business of "Lichfield Refrigeration Services," carried on by Mrs. W. J. Elmy at Lichfield, Staffs, etc. Nominal capital: £5,000 in £1 shares. Directors: Mrs. W. J. Elmy, Miss Vivian M. Elmy and Graham A. Elmy, all of Pipe Hill House, Lichfield, Staffs; Peter Heron, The Mare, Burton under Needwood, near Burton-on-Trent.

Kempston Cold Storage Co. Ltd., 3F, Elliott Street, Liverpool. Secretary: Lenore M. Davies. Nominal capital: £100 in £1 shares. Directors: Wm. F. G. Brabin and Betty R. Brabin, 4, Warren Drive, New Brighton, Ches.; Arthur McGeorge, 45, Childwall Mount Road, Liverpool.

Bradley Hallows Refrigeration Centre Ltd., 133, Derby Street, Bolton. Secretary: R. Hallows. Nominal capital: £100 in £1 shares. Directors: John Bradley, 22 Shaw Street, Bolton; Roy Hallows, 44, Prince Street, Rochdale; Louise Bradley and Sybil Hallows.

Central Refrigeration and Heating Engineers Ltd., 68A, Sycamore Road, Handsworth, Birmingham, 21. Secretary: J. W. E. Woodward. Nominal capital: £1,000 in £1 shares. Directors: Philip F. Burgess, 834, Alum Rock Road, Ward End, Birmingham; John W. E. Woodward, 340, Londonderry Road, Oldbury, Worcs.

The Institute of Refrigeration Bulletin

Institute Headquarters: New Bridge Street House, New Bridge St., London, E.C.4 (CENtral 4694)

MEMBERSHIP

At the meeting of members held on March 2, 1961, the following were elected to membership of the Institute :—

Members

*Alison, Alexander Sidney, 90 Pollards Hill North, Norbury, London, S.W.16.

*Snell, Stephen Charles James Christopher, 128 Priory Crescent, Southend-on-Sea.

*Transfer from Associate Member.

Associate Members

*Abrahams, George Charles Edward, 5 Gateside Road, Upper Tooting, London, S.W.17.

Higham, David Walter, 23 Heathview Crescent, Dartford, Kent.

Needham, Frank Barnard, 91 Glendevon Road, Liverpool, 16.

*Transfer from Graduate.

Companion

Conway, Leonard Charles, 7 Alder Hill Grove, Leeds, 7.

Associates

Bowring, Percival Sidney Robert, 10 Rodwell Close, Kinson, Bournemouth, Hants.

Carter, Keith Denis, "Bishops Court," Pine Walk, Upper Bassett, Southampton.

Coulter, James MacKenzie, 24 Milton Grove, Eastfield, Edinburgh, 15.

Griffin, Cornelius Stephen, 314 Hempstead Road, Watford, Herts.

Hotchkiss, Ian Hay, c/o West African Cold Storage Co. Ltd., P.O. Box 177, Lagos, Nigeria.

Nichols, John Arthur, "Lynton," 134 Whitehill, Chesham, Bucks.

Smith, Bernard Maurice, 10 West Ridge Gardens, Greenford, Middlesex.

Steele, Anthony Devereux, 54 Winton Road, Reading, Berks.

Tweedie, George Pithie, 21 Kingsway, Woking, Surrey.

Graduates

Brown, Anthony Harold, Boghall, Milngavie, Glasgow.

Wood, Edmund Thomas, 18 Robinson Road, Colliers Wood, S.W.17.

Students

Eddowes, Edmund Patrick, 42 Paterson Street, Birkenhead Cheshire.

Winsborrow, Ian William, 12 Milner Street, Birkenhead, Cheshire.

SYMPOSIUM ON THERMAL INSULATION

AT the joint meeting of the Institute and the Low Temperature Group of the Physical Society and the Institute of Physics held on March 2, Mr. G. Yate Pitts, M.ENG., member, spoke about "The mechanics of frost-heave."

Mr. Yate Pitts commenced by recalling a prominent feature associated with frost heave, *i.e.* the particle size of the subsoil. Where frost heave has occurred it is observable that the subsoil contains a large proportion of fine silt and clay with particle size around 0·01 m.m. In the most acute case which had come to his notice, the proportions proved to be 90·2 per cent. and in the least acute case 45 per cent. The former is exceptionally high while the latter is considered to be close to the probable lower limit of frost heaving soils. A feature of such soils is reluctance to drainage.

In the U.K. it is usual for the insulation of cold stores to be designed to give a heat flow around 2·25 B.t.u./ft.²/hr. or a little more in the case of temperatures much below zero F. But as heat is extracted from the subsoil through the floor insulation and is not balanced by inflow of heat in the earth's crust—particularly in winter—the 32° F. isothermal plane descends from its original position within the thickness of the floor insulation, reaches the plane of contact between the insulation and the base on which it is laid, and goes on to emerge into the subsoil itself. By the time that the plane of contact is reached the rate of heat flow will have diminished to 1 B.t.u./ft.²/hr. or less. Considering the sensible and latent heat which must be extracted from water before ice is formed, it is surprising that such a low rate of heat extraction can produce such extensive damage. Obviously the process is slow. It is usual for frost heave to remain unrecognized for 18 months or so after starting up. If allowed to continue structural damage will be such as to demand remedial measures in three of four years.

The thought arises that if a sufficient flow of draining water should pass through the subsoil under a cold store building this would of itself provide a supply of heat to compensate for that extracted through the floor insulation and so render unnecessary any heating device such as an electric mat. Unfortunately the type of soils prone to frost heaving are those which offer high resistance to drainage flow. No soil of whatever type is a homogeneous solid but contains voids amounting to some 30 to 45 per cent. by volume, depending on particle size. The volume of void space of any given sample of soil can be determined and supposing that this volume is completely filled with water, the increase in volume consequent upon freezing of the water can be calculated. But the amount of heave measured is much greater than that which can be attributed to this cause. Further it frequently happens that ice unmixed with soil occurs in fairly distinct layers, or lenses as they have been termed. There does not seem to be any regular order in this lens formation and thickness may be as little as ¼ in. or as much as 2 in. The distance apart of the lenses is also irregular.

This aggregation of water still requires explanation. Evidently in winter a temperature gradient exists in a radial direction in the subsoil when the general sense of heat flow is rejection from the earth's surface. In part this exists also in summer particularly with large cold store buildings but the configuration is altered because of lateral heat flow near the earth's surface consequent upon the reception of heat by solar radiation. This affects a considerable area of the floor adjacent to the outer walls and an isolated refrigerated building—that is, a building which has no contiguous buildings which could provide a source of heat supply to the subsoil—will not reveal ice formation within 5ft. or 6 ft. of the perimeter. This may be imputed to the recovery period afforded by the summer season. Many refrigerated buildings possess a welcome source of heat supply to the subsoil. In some cases the cold room(s) are contained partly or wholly within a larger building and even if this is unheated, it is at least not subject to the normal degree of heat rejection in winter as is uncovered ground. In other cases an engine room is arranged alongside the cold room and provides a useful source of heat supply. If the containing building is heated the conditions are better still. But the greater the width of the cold room, the greater the risk of frost heave.

Difference of vapour pressure, consequent upon the temperature gradient in the subsoil set up by a refrigerated building, is only of the order of 0·04 p.s.i. per ft. of depth. It would seem that capillarity of the finely divided soils, such as silt and clay, is the main factor in the causation of frost heave. One American authority considers that the relative lack of cohesion of fine silt coupled with high capillarity makes silt more dangerous than more finely divided, but cohesive, clay. A lift of 6 ft. 6 in. is suggested as not abnormal. It seems a possibility that supercooling of the water occurs and that freezing has an " explosive " quality. This might provide an explanation of the lens formation observed but could hardly affect the total amount of heave occurring. Samples of soil taken while still frozen from under buildings which have heaved have proved to contain from 33 to 60 per cent. of water by volume, while occasionally a small piece of ice (virtually 100 per cent. water was found.

The refrigerating industry still awaits some simple means of determining the maximum width of building which—at a given temperature and with a given thickness and substance of insulating material—may be considered to be immune from frost heave and so need not incur the expense of an electric, or other, heating mat. It is more usual for a heating mat to be incorporated in a specification simply as a precautionary measure than for reliance to be placed on soil analysis of the site. Local conditions vary greatly and include geographical latitude and contiguous buildings or other source of heat supply to the subsoil. It would seem to be a matter of difficulty to take account of such varying conditions even empirically. In the last decade several authors have put forward mathematical solutions to determine the minimum thickness of a given insultant necessary in a refrigerated building to prevent the irruption of the 32° F. isothermal through the plane of contact of floor insulation and base concrete. Where the thickness of floor insulation at the outer wall can be normal for the temperature difference involved, that at the centre of the building may need to be several times that thickness. The high cost of such additional insulation, and difficulties with floor levels, are considerations sufficient to induce resort to the provision of a suspended ground floor or of a heating mat as a means of securing immunity.

Those who are interested in the mathematics of the problem may care to look up the following :—

Ward W. H. & Sewell E. G. Géotechnique 1950. 2. (1).
Saint Girons. Bulletin's I.I.F. annexe 1953–1.
O. Deublin. Kältetechnik. March 1950.
de Beer. Bulletin's I.I.F. Tome 36. No. 5. 1956.
Stradelli. Proc. 10th Int. Congress. Copenhagen, 1959.

Anyone coming to the subject for the first time may refer to Mr. Yate Pitts's paper before the Institute of Refrigeration and recorded in Vol. 51 of the Proceedings 1954–55. Several references occur in American publications since the frost heaving of roads, not by artificial refrigeration but by natural means has long been observed. There is still opportunity for the scientist to afford assistance to industry in defining the precise mechanics, and limits of expectancy of frost heave.

THE INSTITUTION OF ENGINEERING INSPECTION and THE SOCIETY OF NON-DESTRUCTIVE EXAMINATION

All who are concerned with engineering inspection and non-destructive testing will be vitally interested in a national conference which is to be held at Oxford in September, 1961, to discuss the function of management in relation to inspection, the economics of inspection and non-destructive testing, and the recruitment, education and training of inspection staffs.

This conference is being planned at the request of the Joint Committee of Materials and their Testing and the British National Committee for Non-Destructive Testing. It is being organized jointly by the Institution of Engineering Inspection and the Society of Non-Destructive Examination. The speakers invited are all closely associated with their subjects and have wide experience in the fields concerned. Sessions will be arranged to allow ample time for discussion.

In view of the wide interest already expressed by industry, learned societies and the teaching profession, residential accommodation at Queens' College and New College, Oxford has been reserved over the period September 5 to 8, 1961. The total cost including Conference fee, accommodation and all meals in College will be £9 10s. per delegate.

Those who wish to have further information should write to the Oxford Conference secretariat, The Institution of Engineering Inspection, 616 Grand Buildings, Trafalgar Square, London, W.C.2. This will involve no obligation but will ensure that full details will be sent as soon as they are available.

ESSAY COMPETITION

The journal " Research " is this year sponsoring The Waverley Gold Medal Essay Competition for the ninth year in succession. The Competition is designed to encourage the scientist in the laboratory and the engineer in the production plant to express his views and translate his work into an essay that will be readily understood by other scientists, directors of industrial firms and others interested in science and technology.

The Waverley Gold Medal, named after and bearing the coat of arms of the late Lord Waverley, together with £100 will be awarded for the best essay of about 3,000 words describing a new project or practical development in pure or applied science.

A second prize of £50 will be awarded and also a special prize of £50 for the best entry from a competitor under the age of 30 on July 31, 1961. If the first prize is awarded to a competitor under the age of 30, the special prize will go to the next best entry. Entry Forms can be obtained from the Editor of "Research," 88 Kingsway, W.C.2.

The last date of entry is July 31, 1961.

SHOP REFRIGERATION NEWS

MEAT DISPLAY UNDER CONTRASTING SITE CONDITIONS

By Our Special Correspondent

LAST autumn, Mr. Sydney Sim, trading under the name James A. Kidd at 168, Broughty Ferry, acquired the adjoining shop, formerly a fruiterers. He decided to merge the two premises, to equip the substantially expanded shop on the most modern principles and in accordance with the provisions laid down in the Food Hygiene (Scotland) Regulations Act 1959.

In conjunction with the architect, Mr. James Parr, D.A., A.R.I.B.A., the extended premises were laid out on an open principle, so that all activities with the exception of sausage and cooked meat preparation would be in full view of the customer.

The exterior has been given a new design on both frontages of this prominent corner site, and the combined result is one of the most distinctive and functionally effective butchers' shops in the United Kingdom.

Window display as normally understood has not been used ; but, behind each of the two windows of the selling area of the premises there is a refrigerated cabinet. The one seen behind the window on the return frontage (Fort Street) is a Frigidaire (model KFR 137) cabinet for frozen foods. This has a capacity of 13·7 c.ft. (348 lb.), and is fitted at back and sides with vertical screens of clear plate glass.

The cabinet in the front window is a Frigidaire (model S.O.6). Known as a Commando, it has a clear-glass screen in front and at each end, and is set at right angles to the main service counter, so that while its content can be easily inspected through the window by customers before entering the shop, they are also readily accessible for quick service over the counter. Its operating equipment consists of a DX type cooling coi under the rear shelf and a model MMA2 $\frac{7}{12}$-h.p. sealed rotary condensing machine.

These cabinets were supplied by Turner & Co. (Glasgow) Ltd., Frigidaire distributors for this district. The shop-

Fig. 1.—Two windows in this fine corner shop at Broughty Ferry are occupied by Frigidaire cabinets installed by Turner & Co. (Glasgow) Ltd.

fitters were Aimers (Dundee) Ltd., by whose courtesy the exterior and interior photographs of this shop are reproduced. Turners also increased Mr. Sims's storage accommodation by installing a new cold room of 530 c.ft. capacity and of the following dimensions : 11 ft. 6 in. by

Fig. 2.—The Commando cabinet in Mr. Sim's shop runs at right angles to the main counter: combining effective window display with facilities for quick service.

8 ft. 6 in. by 7 ft. 11 in. high. It is insulated by 3-in.-thick polystyrene and maintains a temperature of 32° F.

The refrigerating equipment for this cold room comprises a Frigidaire A.G.2 7½-h.p. air-cooled condensing machine operating in conjunction with an SWF wall-mounted, force-air cooler consisting of three major parts—

Fig. 3.—A side view of the Hussmann cabinet in the right-hand window of Mr. Munks' shop at Mansfield.

casing, finned evaporator, and motor-driven fan. The casing is made of corrosion-resisting aluminium with a cream finish of high-baked enamel, the evaporator is of seamless copper tubing with closely-spaced aluminium fins, and the fan is a multi-blade propellor type.

In Mansfield, Notts, there is another interesting example of a corner shop with a refrigerated cabinet in a window on each front. This shop of Mr. K. L. Munks at 80, Westgate has been replanned for all-refrigerated display combined with quick over-the-counter service.

Here there are three Hussmann cabinets installed by Mansfield Ice and Cold Storage Co. Ltd. Behind the right-hand window—that is to say the one on the main frontage—there is a 9-ft.-long cabinet held at 33° to 37° F. for the display of the smaller cuts of fresh meat. This display is accessible for service from behind the counter which runs at right angles. In the other window there is a Slimline model for the display of quick-frozen foods.

From the side view of this cabinet shown in the third illustration it will be noted that it is sufficiently capacious to accommodate a very representative display, the refrigerated area containing no fewer than 16 trays in two rows of eight each. The flat surface at the back is used for supplementary display and this, combined with the contents of the hanging rail above the cabinet, results in the kind of comprehensive and hygienic presentation that should typify the butcher's shop of to-day.

In the other window there is a Slimline model for the display of quick-frozen foods. The flat surface at the back of this cabinet carries displays of showcards and price-boards arranged to face inwards for the guidance of customers inside the shop and outwards for the informa-

Fig. 4.—Mr. Munks withdraws one of the joints displayed in his Cascade cabinet. On the left, a Slimline cabinet supports a frozen food display in the other window.

tion of those who are having a preliminary look through the window before deciding to enter.

It is significant of the development of this class of merchandize that in each of these two butchers' shops of contrasting modernity it is found worthwhile to give up one complete window to frozen foods.

The third cabinet in this shop is a Cascade, which although brought out by Hussmann for smaller cuts of meat in ready-wrapped form is used in this instance for displaying the larger joints at the three levels of refrigerated display, while ancillary items are shown along the top.

In the retail market of the Potteries town of Tunstall, there is an all-refrigerated stall run by the brothers W. E. & K. Dodd, who carry on a very old-established family business. This stall is, in fact, a Hussmann cabinet, slightly adapted to meet retail market selling conditions : *e.g.* it supports hanging rails for top display. It was installed by Midland Refrigerators Ltd., of Hanley, another of the six Pottery towns in the connurbation of Stoke-on-Trent.

Another business run by two brothers, who are fully aware of the attracting powers of refrigerated display, is

that of R. Gledson, with four shops in Newcastle upon Tyne. The cabinet seen here in the Shields Road Branch is a Frigidaire installed by H. C. Troldahl Ltd., whose new premises in Scotswood Road, opened by the Lord Mayor of Newcastle upon Tyne last month, will be described in the next issue of MODERN REFRIGERATION.

Fig. 5.—A Hussmann cabinet that is also a market stall. Almost facing the entrance of the retail market at Tunstall, it supports a top display of larger joints.

HUSSMANN BRITISH REFRIGERATION LTD

Hussmann British Refrigeration Ltd., will be showing for the first time at the Self Service and Shop Display Exhibition their new three tier refrigerated display case for the self-service of pre-packed meats. This is known as the Cascade for meats and is already operating with extreme success in a number of self-service stores and supermarkets. Another new cabinet on show will be the latest Hussmann Delicatessen case which has been designed to meet the needs of those self-service operators who feel that the ideal delicatessen department should offer assistant service whilst at the same time retaining all the hygiene and visual appeal of the self-service display cabinet. Other exhibits will include the Hussmann four deck Cascade for dairy products and various single tier cabinets for frozen foods, fish and fresh fruit and vegetables.

The "Refrigerant Piping Data" booklet which the Air-Conditioning and Refrigeration Institute has had in preparation for several years is about to be published, according to Frederick J. Reed, A.R.I. chief engineer. The new booklet, containing information in tabular and chart form not available elsewhere, supplements the ready-reference information with a discussion, with suitable references, of the basis for refrigerant piping design including instructions, with worked-out examples for application of the tables and charts. It contains 64 pages.

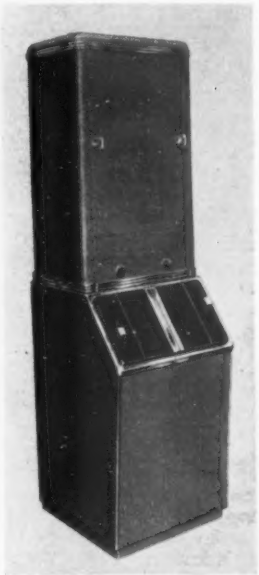
COMMERCIAL AND INDUSTRIAL SECTION

Manufacturers' and Distributors' News

The commercial refrigeration firms in Scotland were very fully represented at **Scotland's Food Exhibition** which was held this year at Dundee from April 4 to 15. Main attention in the equipment hall was devoted to fixtures for the retail trade with John E. Bastow Ltd. of Edinburgh showing Prestcold, Dollar-Rae Ltd. of Glasgow showing Levin and McClary-Easy (Canadian) equipment, W. E. Dryden of Dundee, wholesale frozen food specialists using Prestcold to show a wide range of Findus, Prime Cut, Tempo and Young's foods, L Sterne and Co. Ltd., handling Sternette equipment and Turner and Co. (Glasgow) Ltd. exhibiting the Frigidaire range. Originally staged in Glasgow every second year this exhibition will now be extended to run in Edinburgh, Dundee and Aberdeen in the alternative years, the Dundee event being the first of its type.

A new company, **Heat Pump and Refrigeration-Scottish Ltd.**, has been formed by Scottish Aviation Ltd. at Irvine, in Ayrshire to manufacture portable refrigeration trays. Scottish Aviation Ltd. were the pioneers of aircraft production in Scotland many years ago and are still concerned in that field but have been diversifying their work considerably, to meet the obvious demands of current trends and the contraction in the aircraft field. One such diversification has been development of light engineering productions and metal fabrication and manufacture of the portable refrigeration trays is one such move. The output is limited but a considerable potential is visualized in the café, restaurant, bar and soft drink retailing field. During the summer, the policy will be to determine market reaction and to base future policy of the indications given then of the future scope and demand. Mr. T. D. Robertson, of Scottish Aviation Ltd., believes that this could be developed into at substantial part of their activities.

For the user who needs a constant supply of clear hygienic ice in either cube or crushed form, **Carlyle Air-Conditioning and Refrigeration Ltd., London,** have produced a new automatic icemaker. Designed for



The Carlyle 26H Icemaker.

use in hotels, hospitals, bakeries, restaurants, vegetable and fish markets, poultry stores, dairies and other quantity ice users, these icemakers are available in two models, the 26H3 and 26H5, with production capacities of 220 lb. and 450 lb. of ice every 24 hours. Up to 8,500 uniform cubes of ice will be produced in the larger unit in one day's operation, and stored in a stainless steel lined storage bin, which can be matched to suit the needs of the user from three sizes—100, 160 or 240 lb. capacity. If required, both models can be supplied with a crusher, which will provide three different sizes of flake ice and when a crusher is fitted the icemaker will produce both cube and flake ice as needed. The Icemaker occupies the minimum amount of floor space and fitted with 160 lb. capacity bin, takes up an area of only four sq. ft. Completely automatic in operation, the stainless steel freezing columns are flushed by jets of water after every ice harvest to remove any minerals or other deposits that remain. Each cube is formed individually and gravity dropped into the storage bin.

Mr. Maurice S. Ware, who has recently taken up an appointment as marketing services manager with Birds Eye Foods Ltd., comes to the company from the Prestcold Division of Pressed Steel Co., Ltd. where he has been general manager in the London region since 1960. A pioneer in many aspects of refrigeration, Mr. Ware has joined Birds Eye because he believes in the immense potential that exists in this country for the quick-frozen food industry. He feels there is no limit in its expansion, and that some of the most interesting future refrigeration developments will be in this field. His own experience covers many facets. After taking

Mr. Maurice S. Ware.

an honours degree and a National Diploma in Mechanical Engineering at London University in 1941, he was commissioned in R.E.M.E. and spent five years in the Far East and at G.H.Q. India. He developed mobile refrigeration plant for use by the forces, and also controlled the maintenance and repair organization specially set up to deal with all types of refrigeration and air-conditioning equipment. Returning to civilian life Mr. Ware joined the London office of Prestcold. As

chief sales engineer and special applications manager at Oxford, he led the team which evolved one of the very first hyperthermia machines, enabling the temperature of the human body to be reduced drastically so that surgeons could carry out delicate heart and brain operations. As commercial sales manager and later marketing manager for Prestcold's commercial refrigerators, he introduced one of the first fully automatic forced air display cases for quick-frozen foods in this country. Mr. Ware was educated at Bolton School, and trained by joining the firm of J. and E. Hall refrigeration and general engineers as a pupil engineer in 1937.

This revolving stand, with large mirror and two "Whispair" units, was an eye-catching feature of the Temperature Ltd. stand at the International Refrigeration and Air Conditioning Exhibition at Earls Court

Mr. N. A. C. James, southern England area manager, Cape Insulation and Asbestos Products Ltd., has been appointed "Controller, Government Contracts Division," with special responsibilities for liaison with the Admiralty, the Fighting Services and British Railways. This is a new post. Mr. James joined the southern England area sales staff of Cape Asbestos in 1950 and succeeded Mr. A. G. Grant as area manager in 1953. Mr. N. H. Wimhurst, who has been Senior technical representative in s.e. area for the last eight years, becomes the new area manager.

* * *

Chamberlain Industries Ltd., have introduced a 1½ in. capacity, hydraulic three-point bending machine into the Staffa range of pipe bar and section benders. Suitable for use by heating and ventilating engineers, plumbers, gas and electricity boards, oil, petroleum, refrigeration and general engineers, builders, electricians and general maintenance men, the machine which is sturdy and of robust construction bends nominal bore steam and gas pipes up to 1½-in. diameter. The bender, which has been designated the B2 and which does not require a bench or stand, consists of a powerful hydraulic pump ram unit, a forming head assembly and centre formers for ½-in to 1½-in. nominal bore pipes to BSS.1387. The whole assembly complete in a wooden case weighs only 110 lb. and a particular feature of the machine is the angle of bend indication marks cast in one end of the formers which provide a useful guide during the bending operation of all pipe sizes within the capacity of the machine. The hydraulic unit permits easy and "one hand" operation. Very little maintenance is required and when an overhaul is due the various seals and washers are easily removed. The machine is, of course, much faster than any screw type bender and a full 90° bend can be made in 1½-in. pipe in 60 seconds. The price of the complete machine, including formers and the wooden case, is £35 and it is claimed that the machine will recover its cost in a very short time.

* * *

Mr. John Bass Junior has been appointed sales manager of **B.M.B. (Sales) Ltd.** of Crawley. Previously Mr. Bass has been handling marketing and sales promotion for B.M.B. He is also a director of S.B.W. (Coldheading) Ltd., manufacturers of precision rivets, pins and contact studs. B.M.B. (Sales) Ltd. are the sole agents for the British Manufactured Bearings Group of Companies, covering a variety of products, including—miniature precision balls and bearings—the John Bass range of pressurized assembly cabinets, clean areas and the widely acclaimed man cleaner unit.

* * *

Dewrance & Co. Ltd., announce the formation of the Dewrance Metals Division. This will consist of the foundry at Hillington and the special alloys division in London. The new division will have its own board of management and will be responsible for the production and sales of high quality non-ferrous castings, nickel alloy castings, stainless steel castings, "Endewrance" hardfacing and high temperature brazing alloys. The production executive is Mr. J. B. Morton situated at Hillington, and the sales and technical executive is Mr. E. Wallace situated in London.

* * *

The Italian Tortorelli system of ice-cream manufacture and presentation has been introduced into Britain by **Dollar-Rae, Ltd.**, of Glasgow, who have been appointed sole United Kingdom distributors for Tortorelli of Sienna equipment. The basic feature of this system is the use of preserving counters to display a variety of ice-creams on the comparable lines used in the bakery, confectionery, meat and

other fields, giving the shopper a visual presentation of trays, under glass, from which selection can be made. Production of the ice-cream is done in a self-contained section, which adjoins the refrigerated display counter, giving further visual presentation of manufacture. The ices produced are soft and velvety, well worked, produced under a hermetically closed glass bell, eliminating all external contacts and ensuring completely hygienic manufacture. After production in ½-gal., 1-gal. or 1½-gal. quantities, the prepared ice-cream is transferred to a stainless steel tray and displayed under the glass in the refrigerated counter. Temperature is held constantly at 25°, with capacity to regulate according to the goods under preservation. Trays can be arranged according to type or capacity demands, giving customers a visual selection of flavours, with the consequent encouragement to buy, which is lacking when ice-cream is concealed. A very wide range of models of the Zerostand units is produced, with particular emphasis on stainless steel and glass presentation. The Zerostand compressors have been built for low-temperature work and have maximum output, as a result of high precision and controlled construction. The most recent units have the compressors built in as a component part of the display line.

New Poultry Plant.—A new poultry packing station is to be built at Kinfauns, in Perthshire by D. B. Marshall (Newbridge) Ltd. of Newbridge, Midlothian, a pioneer of the poultry and chicken packing industry in Scotland The new station will be a complete unit, designed to process, pack, and distribute poultry produced in the central Scotland area under the current programme of group development which is being pursued in this industry.

QUIZ FOR SERVICEMEN—2

7. What is flash gas ?
8. What is ambient temperature ?
9. Is pumping a vacuum to be prefeqred to purging and if so, why ?
10. What is the latent heat of vaporization ? Give an example in the system.
11. What is the function of insulation ?
12. What is a test cord ?
13. What is a desiccant ?
14. What is the effect of air in a system ?
15. What is the purpose of a condenser ?

Answers to the above should be concise; indeed, each question can be answered in under 100 words and, in most cases, in under 75 words

This feature will appear monthly throughout 1961 and possibly beyond. In July, a book prize will be offered to the person submitting the most correct answers to the first four instalments.

Replies should be addressed to the Managing Editor, "M.R.", 131, Great Suffolk Street, London S.E.1.

Judging the Frigidaire "Gay New Yorker" competition took place on April 20. The panel was headed by Miss Edith Blair, home editor of "Woman," seen here assisted by Mr. Owen Pawsey, editor of "Electrical and Radio Trading" and Mr. Kenneth H. Vere, executive assistant to the general Sales Manager, Frigidaire.

"Do you like it here?," asks Mr. Frederick Erroll, Minister of State to the Board of Trade, as he chats to an employee at Prestcold's new £5,000,000 refrigerator factory at Swansea. The answer from Mrs. Marina Paton, who works in the Plastic Section, was a smiled affirmative. Mr. Erroll paid a flying visit to the plant in an aircraft operated by the Pressed Steel Air Services Division. He was accompanied by Mr. M. A. H. Bellhouse, deputy chairman, Pressed Steel, and Mr. J. R. Edwards, managing director, Pressed Steel. Mr. Erroll also called in at Shoreham Airport 200 miles away—to see latest developments of "BEAGLE"—the new group established by Pressed Steel last year to manufacture light aircraft for personal and executive flying.

Warwick, Macbride and Co. Ltd., refrigeration engineers of 257 St. Vincent Street, Glasgow, staged an exhibition of refrigerated equipment, deep-freeze plant and domestic equipment at Forfar in March with considerable success. This is a relatively new Scottish company having been in existence for over a year, handling a wide range of industrial, domestic and commercial equipment, with the Marco agency as a principal interest.

* * *

A comprehensive range of Chrysler Airtemp refrigeration and air-conditioning equipment was shown by Chrysler Airtemp Limited on its stand at the International Refrigeration and Air Conditioning Exhibition at Earl's Court last month. Equipment featured included radial compressors and condensers as well as room and packaged air-conditioning units.

The stand of Perfection Parts Ltd. at Earls Court, London. In the picture are Mr. Max Coreth, Export Manager of Penn Controls, and Mr. Kenneth Cash, the European Sales Manager.

SELF-SERVICE EXHIBITION

(*continued from page* 479)

erated storage bin, where they will keep indefinitely. As well, there will be the "Scotsman Automatic Ice Cube Machine" the largest of which will produce 9,000 ice cubes per day. The cycle of cube making is 40 ice cubes every 25 minutes in the 100 lb. per day machine. The clear solid cubes with a displacement of 1½ liquid ounces, are made in refrigerated moulds into which water is injected by means of individual jets for each mould. When every mould is full and has frozen solid, they are released by hot-water pressure and the arm which continually circulates beneath the moulds sweeps them through plastic hinged flaps into the refrigerated stainless storage bin. Also included in their display will be two new "IWO Frys" medium temperature display cabinets—the "Model Master 100"—a glass fronted cabinet with 20 c.ft. of refrigerated rear storage space, complete with stainless steel trays and fluorescent lighting:—the model "L 20"—a four tier open-fronted wall type display cabinet with forced air circulation. In addition will be examples from the range of **Sherer** supermarket equipment including merchandisers and tiered wall cabinets.

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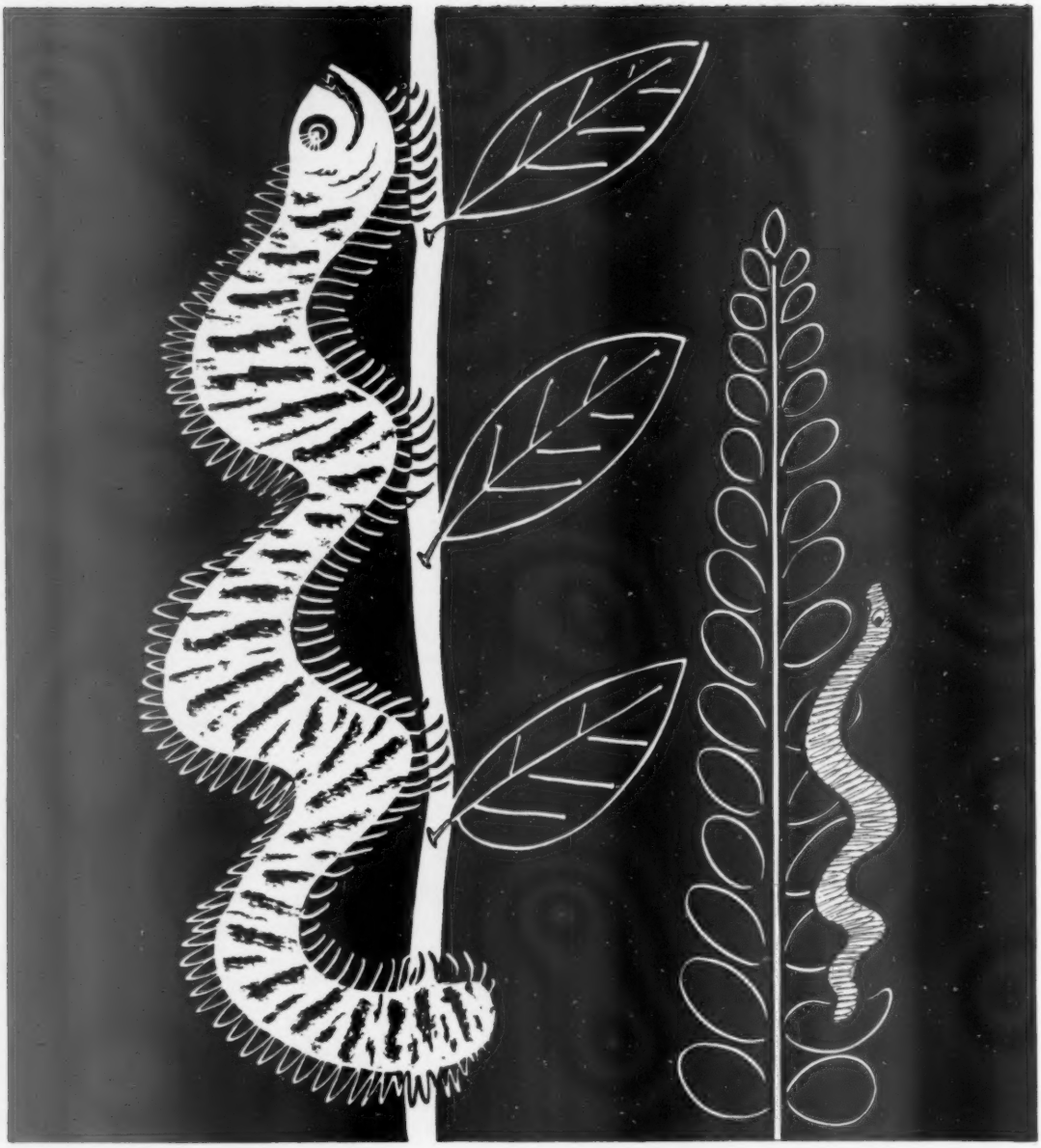

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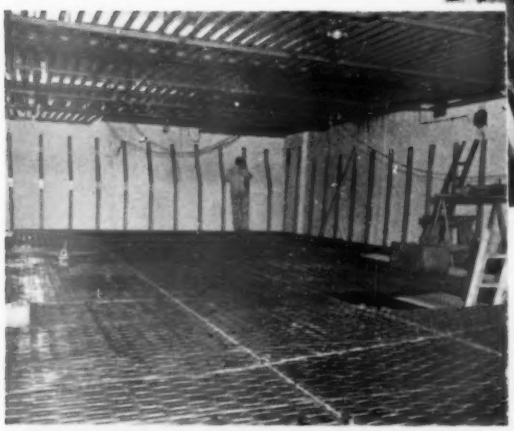
Low Temperature Storage Extensions At Battersea

THE name of **United Carlo Gatti, Stevenson & Slaters Ltd.,** has been synonymous with the ice trade for nearly three-quarters of a century.

Lucrative as has been this business since the 90s, the forward-looking directorate was not slow to realize a few years back that the old established block ice trade was bound to contract in the coming years although it is still running at an impressive level. The chairman and managing director, Mr. A. Corazza, and his colleagues therefore embarked on a programme of converting certain sections of the Battersea premises to low temperature storage, and in the case of their Hackney building, they are transforming this completely into a sub-zero store.



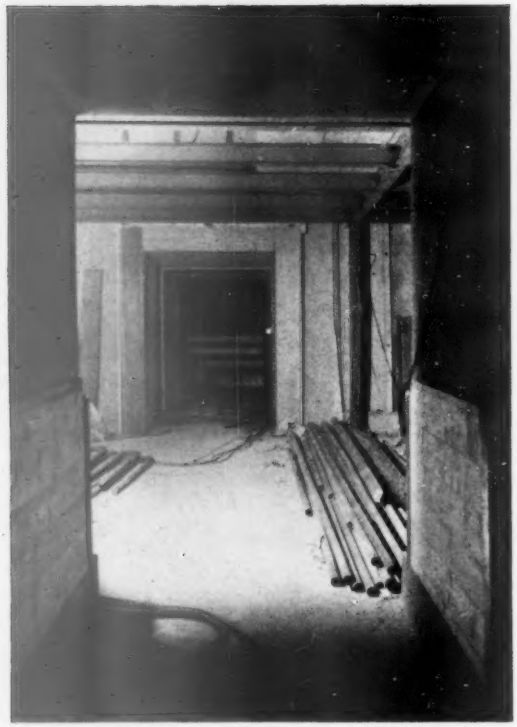
Above: Converting the deep ice wells into storage chambers.

Left: Erection of a mezzanine grated floor in the deep well.

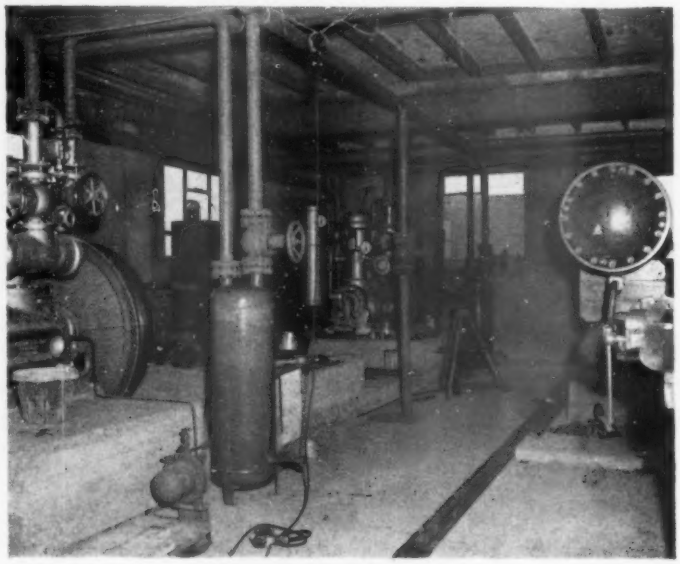
In recent months " M.R." has reported upon two such conversions of space into low temperature chambers at Battersea—these totalling 30,000 c.ft. and 20,000 c.ft. respectively.

Last month, " M.R." again visited Battersea to witness and to photograph the final stages of the metamorphosis of ice storage wells into freezer chambers.

The original ice storage wells were constructed over 70 years ago, 22ft. below ground level. Then ice was brought from Norway by ship, transferred to barges which then subloaded at the company's wharf into the ice wells ; however, the last shipment was in 1921. Now the wells have been converted into sub-zero cold storage rooms of 50,000 c.ft. and a storage capacity of 3,000 tons (1,000 tons in each chamber). The dimensions of the original chamber were : 96 ft. long, 21 ft. wide, and 22 ft. high. To convert the wells for cold storage these chambers were cut in half, and after



Above: The well has been divided into two. Above right: New roof top engine room. Right: A view of the wharfside from Carlo & Gatti's roof. Below: One of the largest engine rooms to be located on the roof.



the necessary alterations and reinsulation there are now three chambers each 46 ft. long, 19 ft. wide and 20 ft. high.

Eight inches of Jablite insulation were used on the floor and walls and 4 in. on soffit. The main cold store is situated immediately above this new development. Due to the table water level a false floor has been constructed to allow for the passage of water under these chambers. This point also applied when lift installations were considered, and made it impossible to dig a lift pit; consequently a Becker hydraulic lift has been installed.

The chambers have a most unusual feature. Due to their height and the impossibility for various reasons of using mechanical handling, mezzanine flooring has been installed in each chamber so that in effect they have two floors. This work has been carried out by Campion Bros. Deptford, a firm which Carlo Gatti has employed for many years. The dividing wal's between chambers are the original ones, and these proved quite a problem for the contractors when cutting through the doorway—they are 4 ft. 6 in. thick and of solid concrete.

(continued on page 519)

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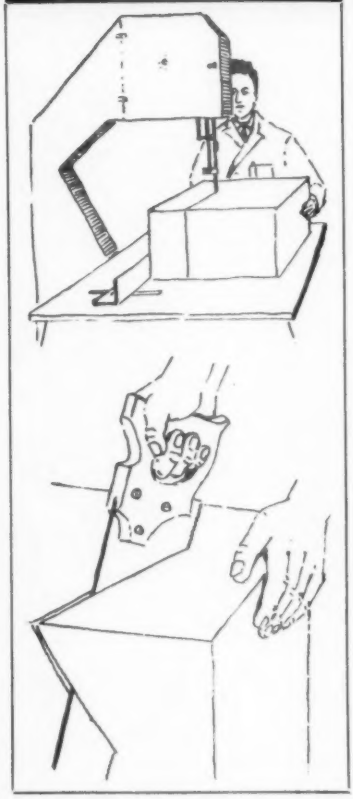

Electrolux International Service Conference

Representatives of seven companies in the International Electrolux Organization visited London from May 1 to 6 for an International Service Conference which was held at Electrolux Ltd.'s offices at 419, Oxford Street, W.1.

The delegates, from Electrolux service departments in Belgium, France, Germany, Italy, Sweden and Switzerland, were welcomed by Mr. Stanley Broughton, managing director of Electrolux Ltd. The main purpose of the conference was to give delegates the opportunity to study British service methods which were shown and explained to them by Mr. Frank Reeve, service manager for U.K. and Eire. In addition to an intensive series of conference sessions, they visited the company's refrigerator and cleaner factories at Luton, and Luton Hoo, home of Sir Harold Wernher, the company's chairman.

A Selection of Abstracts from Papers presented at the Convention held in conjunction with the International Refrigeration Exhibition Earls Court

Refrigerated Vehicles

By Dr. F. L. LEVY,
M.Inst.R., M.Inst.M., Mem.ASHRAE

THE only one class of service which the user of insulated or of refrigerated transport equipment, regardless of its type, may expect consists of a protective service. He may neither expect that any form of applied refrigeration will or can improve the initial quality of perishable foodstuffs, nor may he reasonably expect that the temperature of the cargo will be appreciably lowered during the journey. Any maker of refrigerated transport equipment is therefore perfectly correct and justified when assuming that, whenever a particular transport temperature is specified, the cargo will be loaded at that temperature and that it has been pre-cooled either by icing, or in a cold store or in a mobile pre-cooling station. While it is, of course, possible to combine or associate any type of insulated or refrigerated transport equipment with any form of stationary or mobile pre-cooling equipment, I would like to make it very clear that, in that case, two distinct duties are allocated to the respective equipments : one requiring a comparatively powerful plant for cooling down a load of warm cargo in a short time, the other one requiring comparatively small power or no refrigeration at all for subsequently protecting the cargo at low temperature against undue temperature rise.

To avoid recurrent misunderstanding and frequent disappointment of users of refrigerated transport equipment, it might not be out of place to summarise here the service which the user of refrigerated transport equipment may expect from his equipment :

(1) Do not expect from insulated or refrigerated transport equipment more than purely protective service. As this service will protect valuable perishable cargo against the known adverse effect of undue temperature rise, the use of this method of transportation fully justifies its application.

(2) When using this method of transportation in conjunction with any form of stationary or mobile pre-cooling equipment, do not expect this equipment to remove heat at a rate faster than the nature and arrangement of the cargo is able to release.

The majority of mechanical equipment for low temperature transportation operates on the well-known vapour compression cycle comprising the so-called condensing unit, an air cooler with forced air circulation and a thermostat. The compressor may be driven either from an electric motor or a special petrol- or diesel-engine, or from the engine of the truck. There are also units available with a dual drive in which case the engine can be shut down while the van is parked and the compressor is driven by a standby electric motor taking its current from a plug. So far the use of the so-called air cycle has been limited to temperatures above freezing point for air-conditioning of passenger aircraft.

With regard to the operation of any piece of mechanical equipment installed on board of a moving vehicle it might be useful to keep the following in mind. Whenever a household refrigerator cabinet is shipped from one place to another, it is carefully packed and crated for transport in order to protect it against accidental damage and the usual hazards of the road. Nobody would attempt to plug it in and to take it into operation while it is on its way from the factory to the wholesaler, or from the wholesaler to the retailer. To anyone asking a question in that connection the simple answer would be that the unit is not made for that purpose. This answer indicates that any condensing unit, any evaporator, any piece of pipework and any component of equipment down to the last nut will require to be made or selected specially for the purpose of installation and operation on board of a vehicle which is exposed to shocks, vibration, varying gradients of the road, varying conditions of ambient temperature, altitude and air pollution.

The design and manufacture of appropriate equipment for these exacting duties has become a speciality and various units and methods of drive are now on the market which offer reliable service, always provided they are properly maintained and operated in accordance with design conditions and the manufacturer's instructions. As the users of such equipment will usually be the first ones to find out where body-builders and manufacturers of the refrigeration equipment have failed to co-operate

at a very early stage of the work, the necessity of very close collaboration between the two parties cannot be over-emphasized. The same refers to the necessity of a very clear and concise service manual and instruction book whose appropriate place should not be at the user's head office, but in the driver's cab or in the machinery compartment of the van or container.

Refrigeration in Fishing Vessels

By G. C. EDDIE,

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ADEQUATE chilling and insulation from external heat are only part of the requirements of good practice in the handling and stowage of fish at sea. The fish must be promptly gutted, well washed and got below as soon as possible, without rough treatment at any stage. Even so, only the most expensive species will keep in acceptable condition for more than three weeks ; cod and haddock, the bulk of the catch, can be counted stale at 12 days and are usually condemned at 16 days, while herring are unsuitable for some purposes after one or two days. The trend of fishing, the seasonal fluctuations in supply and the perishable nature of the product have led to a growing interest in freezing at sea on the part of the deep sea trawling section of the industry.

Freezing at Sea

Most species of white fish, if properly handled and stored in ice at all stages from catching to consumer, can be regarded as reasonably fresh for up to 10 or 12 days, fresh up to six or nine days and very fresh up to three days after catching. There is therefore little incentive to equip the Near- and Middle-water trawling fleets with quick-freezing plant and low temperature holds, merely in order to improve the quality of the fish at the time of purchase by the consumer. Over half of all the white fish landings, however, come from the Distant Waters and the fish will be from 6 to 18 days old or more at time of final purchase. Moreover, the Distant Water fleet faces diminishing catches and is beginning to range further afield in an attempt to maintain supplies. The main interest in freezing at sea is therefore manifest in this section of the industry.

At the same time the Middle Water owners have not been entirely lacking in interest, for more than one reason. A freezing plant would allow extension of the voyage at times of poor fishing ; properly frozen and stored fish can be kept from seasons of surplus to seasons of scarcity, and, although very acceptable packs of frozen fillets and the like can be produced on shore from very fresh fish, a quick-frozen fish equal in every way after thawing to very fresh fish—suitable for first-class smoke cures, for instance—can only be turned out from fish frozen within three days or so of catching, and, ideally, fish should be frozen pre-rigor. Among the difficulties that face the designer of freezing plants for Middle-Water vessels are the lack of space and the wide variety of shapes and sizes of fish to be frozen.

In the Distant Waters the main species are cod and haddock, although freezing at sea bids fair to popularise other, and more prolific, species, which so far have not found favour with the trade and the public, owing to the difficulty for one reason or another of preserving them in ice in an acceptable condition.

Two main lines of development are being pursued by the industry : the factory trawler and the freezer-trawler. There is a third possibility, *viz.*, the mother ship with attendant fleet of catchers.

Factory Trawlers

Chr. Salvesen and Co. built the first commercially viable factory trawler in 1953 and there are now three factory trawlers in the Salvesen fleet ; there is also a large number of similar vessels built by the Russians. These factory trawlers are much bigger than orthodox trawlers and cost three times as much. The British vessels process and quick-freeze the entire catch, most of it being mechanically filleted before freezing. The equipment is very similar to that in a quick-freezing factory on shore. Some of the catch is frozen in horizontal plate frosters and some in hybrid freezers which remove the heat partly by air blast and partly by contact. Horizontal plate frosters need very close supervision if the freezing process is to be carried out thoroughly and at sufficient speed, the main danger being poor contact caused by uneven packing of trays or underfilling of trays and by ridges and nodules of ice on the plates. The air blast is less vulnerable to such mal-operation but is bulkier and produces a pack which is not so regular in shape and therefore stows less well. The Russian vessels, as far as is known, are equipped only with air blast freezers.

Among desirable future developments is filleting machinery which is less bulky and less expensive : for operations at sea a few per cent. of yield could well be sacrificed for greater simplicity and cheapness. The other possible development is the production of sea-frozen consumer packs, but many difficulties will have to be overcome. The typical product of the present-day factory trawler is a 7 lb. or 14 lb. pack of fillets which is destined for the catering trade or for reprocessing on shore, *e.g.* into fish fingers.

Fish which is sea-frozen in the whole, gutted form is as acceptable to the consumer as very fresh iced fish and can be handled, processed and distributed in the same way. In particular, it can give very high quality smoke cures. The factory trawlers produce very little sea-frozen fish in this form. It is, however, the most practicable form in which fish can be frozen on board trawlers of orthodox size and type, owing to the lack of space and labour and also because of the violent motion.

Freezer Trawlers

The freezer-trawler is a vessel of very similar size and type to the largest orthodox trawlers, but equipped to freeze part or all of its catch. Some German trawlers of orthodox distant-water size are so equipped, the fish usually being frozen in the form of fillets in horizontal plate frosters, although one vessel is being equipped with a conveyor-belt type of air blast tunnel. The British are following the rather different line of development suggested above, *viz.*, freezing part or all of the catch in the whole, gutted form. This fish can be thawed at the port as and when demand warrants and can be distributed in the normal way, after further processing if so desired.

Refrigeration and the Fishing Industry

The fishing industry, and the deep-sea trawling industry in particular, is on the threshold of a revolution in methods and in design of equipment. New fishing grounds will have to be sought, perhaps in sub-tropical or tropical waters as well as in the more remote areas of the North Atlantic and Arctic. Whether the fleet will come to consist of factory trawlers, freezer trawlers or mother ships with attendant catchers cannot at present be foreseen. What is almost certain, however, is that there will be a great increase in the use of refrigerating equipment,

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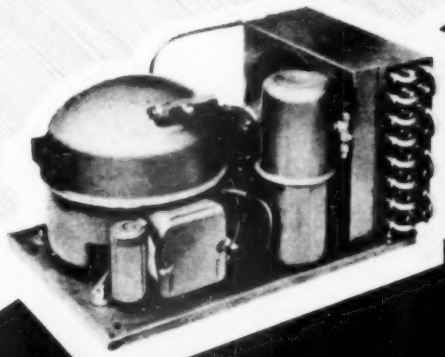

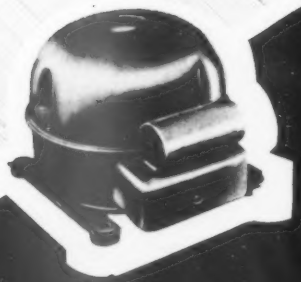

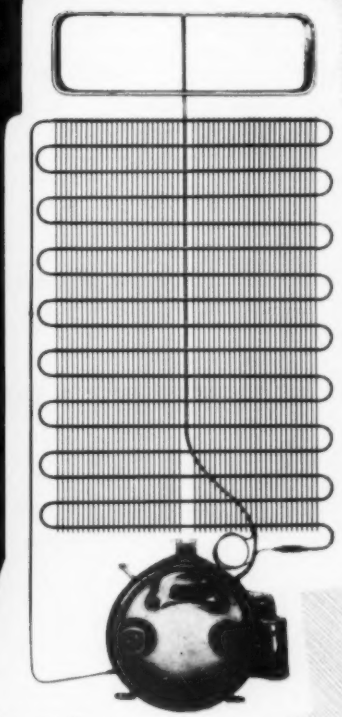

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mainly in the form of ship-borne quick-freezing plants. Such developments are foreseen in the recently-published Report of the Committee of Inquiry into the Fishing Industry, under the chairmanship of Sir Alexander Fleck.

To carry out these changes in the most effective and economic manner requires a thorough understanding on the part of owners, shipbuilders and refrigerating engineering firms of the many factors involved and the interplay of one with another. Due regard must be paid to operational conditions and to the facts of engineering and naval architecture and of fish technology. Commercial development must be backed by engineering and biochemical research on a sufficient scale. Last, but by no means least important, the refrigerating engineering firms and the fishing industry should initiate, in co-operation with the research departments, and at an early date, a programme of training for the specialist Refrigerating Superintendents who will be required to maintain the sea-borne plants and instruct the crews in their proper use.

Pressure Regulating Devices in a Refrigeration System

By W. E. MacMILLAN
Controls Company Canada Ltd.

SYSTEM pressures may be controlled by a series of different devices designed to maintain pressure difference in a system. Some of the most common are as follows :

1. *Automatic Expansion Valves* (Constant pressure valves). This was one of the first metering devices used in a refrigeration circuit. It is basically a pressure reducing valve designed to operate from the outlet pressure. It opens on pressure decline of outlet pressure beyond a preset point. This factor offers a pressure protection, as no refrigerant may enter the evaporator until the evaporator pressure is reduced to the point the valve is adjusted to.

The basic limitation of this device is that it should not be used in multiple, as the valve does not adapt to load changes, but serves only the prime objective of holding the pressure in the evaporator to a given limit during the running cycle.

The automatic expansion valve has found particular use on domestic refrigerators, water coolers, room air-conditioners, etc.

A recent development of this valve has been the " bleed-type," which is a standard valve with a built-in " bleed " or leak, so that the pressures in the system may unload during the off-cycle. This feature enables this device to be used with compressors of low starting torque which normally use a capillary tube as a metering device.

2. The next development over the automatic valve is the *Thermostatic Expansion Valve*, essentially an automatic valve with the addition of a power element to transmit the temperature of the coil to the valve itself, so that the valve will respond to load changes.

3. A recent modification of the TX valve has been to include the feature of " pressure limiting," a valve so designed to incorporate the pressure limit feature of the automatic valve along with the response to load changes as in the TX valve.

Now we shall turn our attention to valves installed on the suction side of the system—or the outlet of the evaporator, in name, Evaporator Pressure Regulators. The normal application of an E.P.R. valve is in a multiple coil system where we want different evaporators to maintain different temperatures. The E.P.R. valve will be installed in the suction line of warmer evaporator and, being subject to the inlet pressure, will limit the temperature which this evaporator may be reduced to. The temperatures in the other coils will be determined by the condensing unit suction temperature.

Another device commonly used in suction service is the crankcase pressure regulator ; this device is subject to outlet pressure and will close off if the outlet pressure increases beyond a present limit. This valve will protect a compressor against abnormal suction pressures and is adjusted relative to compressor specifications. In effect it performs a function of protection similar to the pressure limit type expansion valve, but there are a few differences I would like to clarify.

When using a pressure limit expansion valve, this valve will close off if an undue load is applied to the coil, but the liquid refrigerant in the evaporator is still subject to the added heat load and it is possible for expansion of this liquid to produce a suction pressure in excess of what the condensing unit was designed for and consequently overload the compressor.

With the use of a crankcase regulator, this would not happen. As the evaporator pressure builds up, the crankcase regulator will close off and maintain a compressor suction pressure below the setting on the valve, thus the desired protection would be achieved. When the overload has been overcome, the valve will again assume the open position and allow the evaporator pressure to come back to the condensing unit.

Another interesting application of this crankcase regulator is as a capacity device to maintain a given evaporator temperature on units operating with a continually running compressor, such as direct drive units in automotive air-conditioning or truck transport refrigerated units. In this application the valve is installed in a hot-gas by-pass line between high and low side and set to maintain an outlet pressure equal to the corresponding temperature required in the evaporator. The valve will be normally closed and as the evaporator temperature decreases to our predetermined point, the valve will by-pass a small amount of hot gas that will raise the evaporator pressure and consequently the temperature and will at the same time close off the by-pass valve again.

This is a common application on automotive air-conditioning using direct drive compressors. When the system is adjusted for proper cooling at say, 30 miles per hour, the operator of the vehicle could become quite chilled at 60 miles per hour, as the compressor speed and capacity would increase with the additional engine speed. We have also used this system on small fishing-boat refrigeration systems, where the compressor is driven from the main engine.

We have one other very important pressure to consider and this is the condensing pressure. In water-cooled units we employ a pressure actuated water control valve to admit more or less cooling water to the condenser in response to condensing pressure. Thus we are able to control this pressure within predetermined limits and guarantee an adequate pressure drop across our metering device to achieve adequate capacity.

In the condenser water regulating valve, the condensing pressure is applied to a metal bellows in the valve that actuates a slide covering a part. An increase in condensing pressure will cause the slide to move across the part and open more of it for water flow. This increased flow will cool the condenser, drop the condensing pressure and allow the slide to close off partially the part in the water valve, achieving the control we desire.

BUYERS' GUIDE

The air-cooled condenser offers some additional problems. In many installations, the air-cooled condenser is remote from the compressor room ; this has the advantage of subjecting the condenser to a better supply of cooling air and not subject to heat given off by compressors and motors. However, it does offer the problem of lower winter ambients. If a system is designed for a maximum cooling air temperature of 80° F. and we drop this temperature to say, 40° F., in effect we have a condenser much too large, with the result that the head pressure falls off to the point that the metering devices fail to flood over evaporators and the only way to correct this is to increase the head pressure.

We have a valve which is designed similar to the crankcase regulator, but is subject to inlet pressure that will accomplish this. The valve is usually installed in the liquid leg of the condenser between condenser and receiver. When head pressures are low, the valve will be closed and back the liquid refrigerant up into the condenser. This is effect reduces the area of condenser used to liquefy refrigerant vapours and consequently reduces capacity of condenser, thus the head pressure begins to increase to the point where the valve opens and allows the high pressure liquid to enter the receiver. To keep some pressure on the receiver while the head pressure regulating valve is in closed position, a by-pass is usually installed between hot gas discharge line and receiver. This maintains adequate pressure on liquid in the receiver to force it through expansion valves, even when liquid leg is blocked by the head pressure regulator. As the ambients increase, the valve will assume an open position and normal operation will resume.

Meat and Refrigeration—A Scientific Appraisal

By E. H. CALLOW,

B.Sc., Ph.D., F.R.I.C., M.R.S.H., M.Inst. Meat.

Lately Head of Meat Division, Low Temperature Research Station.

WHEN a solution of any salt is cooled, ice separates out at its freezing point, and the greater the concentration of salt the lower the freezing point. But as ice separates out from a solution the concentration of the salt is increased, and a lower and lower temperature is needed for more ice to separate. Finally, a saturated solution is formed and the solid salt and ice separate out together at a definite temperature, depending on the salt—this temperature is called its eutectic point.

Muscular tissue behaves in the same way—it starts to freeze about 30·2° F. and at 14° F. 90 per cent. of the water is present as ice. Because muscular tissue contains a mixture of salts (chloride, phosphate, lactate, etc.) it has a range of eutectic points and there is some doubt as to whether all of the water has been changed to ice even when the temperature has fallen to 40° F.

The more rapid the rate of freezing the smaller the ice crystals and the greater their number—this is the principle underlying " quick freezing." With meat it can only happen if the warmest point can be cooled from 41° to 23° F. in less than half-an-hour, and this can only be done if the meat is 2 in. or less thick, even if frozen from both sides. Even then, during storage, it must be covered with a film which adheres to the meat and is impervious to moisture. The storage temperature has to be below —4° F. because at 14° F. the small crystals gradually become larger.

The advantage of " quick " freezing is that there is less drip on thawing. Drip is due to the fact that ice crystals (which occupy one-eleventh more space than the water from which they are formed) distort the miscroscopic structure of muscle fibres—the larger the crystals, the greater is the distortion. On thawing, the more open structure allows fluid (drip) to flow away. This is equally true of all carcass meat, but is most readily observed in beef where up to 2 per cent. of the carcass weight may be lost in the butcher's shop. In the home, however, a cut like hip bone steak may lose nearly 10 per cent. of its weight. Such losses are minimised by " quick " freezing when this is possible.

Freezing concentrates the natural salts and during storage this strong solution gradually denatures the protein of the meat, but, this undesirable change occurs more slowly at lower temperatures. For this reason temperatures as low as —4° to 13° F. are better for prolonged storage than is 14° F. At these lower temperatures, there should also be a lower incidence of rancidity (due to a slow oxidation of fat) and of " freezer burn."

Freezer burn is due to the sublimation of ice into water vapour at the surface of the meat. This leaves an unsightly porous structure in which the concentrated salts may cause oxymyoglobin to change to metmyoglobin, giving a grey-to-brown discolouration. The proteins too, will be denatured.

Although the freezing of meat prevents spoilage from micro-organisms, it is now clear that other deleterious changes can occur slowly in cold-storage. Moreover, there is the risk that the fat will take up any odours present in the cold store and diesel oil fumes and vapours from fruit have been known to taint meat in this way. It is possible to remove such a taint by prolonged aeration of the frozen meat, but if air cannot be drawn in from outside, the use of ozone helps by removing the vapour from the air in the store. There is, however, some risk that the ozone will impart a foreign flavour to the fat.

Frozen carcasses become distorted in storage if their temperature becomes high enough for some fat to soften. Most fats begin to solidify at ordinary temperature, but do not finish solidifying until quite low temperatures and, with soft fats such as may be found in pork, complete solidification may not occur even in cold storage. One point frequently overlooked is that there is a latent heat of solidification (about 30 to 45 calories per gram) for fat (just as there is the well-known latent heat of 80 cals per gram for the change of water to ice). For this reason the chilling of meat necessitates a much larger removal of heat than is generally realised.

Theoretically, the amount of heat needed to be removed from meat during freezing will depend on its composition. The fact that the fatter the meat, the less is the water content causes the heat load to remain relatively constant and the engineer will not be far wrong if he assumes that to cool carcasses of meat from 59° to 5° F., 280,000 B.t.u. per ton will have to be removed and with boneless meat, 323,000 B.t.u.

Refrigerated stores for meat must, of course, be made rat-proof—if rats or mice once gain access they can grow long hair and survive in nests in the fat of the meat. Temperature control is important if loss due to evaporation is to be minimised in cold stored meat. It is known that such losses are greater in summer than in winter. Moreover, a cold store has a moisture deficit depending on its construction and working which is independent of the load of frozen meat. Frozen meat in an incompletely filled store thus loses a higher percentage of water vapour than does meat in a full store.

Ice-Cream Manufacture in Great Britain Today

By L. H. KLACKAN,
Neilson's (Ice-Cream and Frozen Foods) Ltd.

AS with all good products it is essential to start with only the best raw materials. In the large factory of today the majority of ingredients are delivered and handled in bulk liquid form. This has meant considerable replanning of space to allow room for the storage tanks and vats required. The capital used, however, can very soon be recovered by the cheaper cost of ingredients and also the considerable saving in labour.

The mix processor of today works before control panels as if he were in command of the latest venture into outer space. He completely controls and directs the correct quantity of all major ingredients through meters and pumps into the blending tanks.

It is as well to realise that good commercial ice-cream today might be analysed into the following formula :

11 to 12 per cent. Fat.
13 to 14 per cent. Sugar.
10 to 11 per cent. Skim Milk Solids.
0·25 to 0·4 per cent. of other ingredients such as Emulsifiers, Stabilisers and Flavours.

From this analysis it is easy to see that the main problems of ingredient handling revolve around sugar, fat and skim milk solids.

Pasteurising

The ingredients that go to make an ice-cream mix are blended with water in many different ways according to individual requirements. Whatever the methods used, in general ingredients are mixed in stainless steel vats and pasteurised. The pasteurising process is laid down by the heat treatment regulations and any of these methods can be and are used. The oldest method of batch pasteurising at 150° F. for 30 minutes or 160° F. for 10 minutes is still an advantage for some mixes, whereas it is better for others to use the high temperature short-time process of 175° F. for 15 seconds. Since 1959, it has been possible to use a sterilising process where the mix is raised to 300° F. for at least two seconds.

Whatever the method used the aims and results are the same, namely, to kill the maximum amount of bacteria that might be present. Legal standards of bacteriological control exist but we in the industry are always working well below those limits.

Either before or immediately pasteurising is finished the mix is homogenised and then cooled to below 40° F. through plate coolers. The homogeniser reduces the size of the fat globules down to less than two microns in diameter and also has the effect of increasing the mix viscosity and resisting separation. The normal homogeniser is a three-throw pump with a two-stage homogenising valve head. By varying these pressures up to 3,000 p.s.i. we can achieve different desired results in our mix.

Most coolers today are plate type with recirculated water to bring the mix temperature down to 90° F. and chilled water or brine to complete the process to below 40° F. It is there that the refrigeration industry plays its first major role in ice-cream manufacture. As we operate each of many sections at 1,000 gallons an hour it is easy to see that we are quite a good customer to them.

From coolers the mix passes through stainless steel pipes and pumps to refrigerated tanks up to 3,000 imperial gallons capacity. There it is stored for minimum periods of four hours to age or mature it. This ageing period improves the flavour and texture and also assists in the next process of freezing.

The continuous freezer of today operates in multiples of 120 or 240 gallons an hour of finished ice-cream. It can be considered (rather too simply I must admit) as a tube refrigerated on its outside, with mix and air pumped through its centre at a controlled rate. At the same time blades along the length of the cylinder rotate and scrape the mix from its inner walls as fast as it forms. This has the effect of whipping air into the mix and ice-cream leaves the delivery end of the freezer at temperatures around 23° F.

The amount of air incorporated depends upon the type of product required and is called the over-run or swell and is usually expressed as a percentage. At this stage I would like to assure you that although the freezer has often been called the dividend machine and more lately, the one-armed bandit, it should be remembered that air is not sold for profit alone. Without air the ice-cream would be completely unpalatable.

The change from liquid mix to ice-cream takes place in approximately 12 seconds and the exchange of heat is very rapid indeed. The refrigeration is an ammonia circulating system with an injector to increase the rate of refrigerant flow over the freezing cylinder. The back pressure is automatically controlled as is the air and mix supply, so as to give a continuous flow of a constantly good ice-cream. Experiments are now being carried out on what we might call ultra-low temperature freezers. Here the principles are the same, but ice-cream can be produced to leave the freezer at around 16° to 19° F. This, we hope, will lead to higher outputs through existing hardening tunnels and a much smoother and better texture.

With all our ice-cream lines we aim at the quickest possible transfer of heat. When heat is removed slowly the ice crystals will be less numerous but larger and the texture, therefore, will become coarse and distasteful. Since only approximately half the freezing of the water is done in the freezer it follows that quick hardening on leaving the freezer is also an important factor in high quality products.

On leaving the freezer ice-cream is in a malleable plastic form and can be piped directly into carton-filling machines, cup fillers or specially shaped extruding nozzles to form brickettes and other different lines.

Transport

To take goods from the factory to the depot we use trunking vehicles that are really like cold rooms on wheels. These have insulated and refrigerated bodies and can carry loads of more than £4,000 worth of product at a time. The refrigeration system inself can be electrically-operated from the mains while the vehicle is being loaded and is run from a special diesel engine when travelling. At depots goods are off-loaded as quickly as possible into cold stores that themselves are maintained at —15° F. and the trunking vehicle is returned to the factory for further loads. These depot cold stores vary in size up to 30,000 c.ft. and are completely automatic in operation including defrosting.

Refrigerated transport is also used to move the product from the depots into the selling sites which are usually confectionery shops. These vehicles are also operated from the mains while in the depot but from a diesel unit when on their rounds.

It is easy to see why so much capital is involved in

distribution. Even the refrigerators and conservators in the shops belong to a great extent to the ice-cream manufacturer who loans them to the retailer of his products.

The newest venture of the industry is to take freshly-made ice-cream directly to the consumer. These soft ice-cream vans have had huge successes in the United States and there is no doubt that the ice-cream served from them is something different. The vehicle is tailor-made to be as self-contained as an ice-cream factory. It has to be supplied only with mix. This is delivered by some manufacturers in sterilised cans which need no cold storage and will last indefinitely. The more general and cheaper method (but none the worse) is to use spray-dried powder mix to which cold water only need be added. When the operator works his van near to a factory he can, of course, use freshly-made mix and keep it in a chilled compartment.

Training and Education of Refrigeration and Air-Conditioning Service Personnel

By R. C. TODD

IT is the purpose of this paper to highlight the inadequacy of the present method of recruiting erection and service personnel and to show how badly supported these men usually are as regards up-to-date knowledge of trends in the design and application of refrigeration in their particular field. Also it will be shown how inadequate the lines of communication often are between the man in the field and the design, drawing office and sales staff.

Refrigeration Training of Erection and Service Personnel

Probably most of those who become erection- and service-men pick up their knowledge both of fundamentals and detailed information from those with whom they have to work. Some do not even have this help and have to learn at the expense of the customer.

There are, of course, a number of firms who run their own service schools and some of these are excellent. There is also a course at one or two technical colleges which use the existing City and Guilds Syllabus No. 72, Refrigeration Practice. However, very few men have taken this course, mainly because the existing syllabus is inadequate to the needs of service and installation personnel but also because so few technical colleges are able to provide or obtain the lecturers needed to run the course. Steps are now being taken to re-draft the City and Guilds Syllabus No. 72 to bring it into line with current ideas of what the servicemen should know and be capable of handling.

A correspondence course has recently been started by the Refrigeration Servicemen's Association to try and meet the needs of many servicemen who cannot attend a technical college and it is hoped this will help to meet their need for good training in fundamental principles. The present facilities are unable to handle very large numbers of students, but it is hoped that these can be expanded as time goes on to suit requirements.

Correspondence Courses

It is recognised that correspondence courses are not the ideal method of training servicemen as they need considerable concentration to pursue them and much perseverance on the part of the student ; they are also unable to provide any practical training or demonstrations. In framing the new City and Guilds Syllabus No. 72, it is hoped that the Syllabus will be arranged so as to permit the use of the sandwich course principle. It must be of sufficiently high standard and must cover the subject as widely as possible. The ultimate object should be to make courses based on this Syllabus the recognised standard requirement for all service personnel and so to raise the status of servicemen.

Keeping the Servicemen Up to Date

Very poor facilities exist for keeping servicemen and installation personnel up to date with the latest developments in air-conditioning and refrigeration applications and practice. Although some firms issue good instruction books and technical pamphlets, the majority do not go much further than producing a description of the construction of the individual parts of the plant and the basic design diagram. Very few are really useful in diagnosing trouble and much time is wasted and inconvenience caused in consequence.

While a good many technical books and magazines are published, only a handful attempt to meet the needs of the practical man on the job whether as an operator, installation or serviceman. Where any attempt is made it is usually obvious that the author does not know the real needs of the serviceman. Some practical information (and, let us say, it is of an excellent nature), is to be found in the publications of the Refrigeration Service Engineers Society and the National Association of Practical Refrigeration Engineers in the United States of America, two societies devoted solely to refrigeration and air-conditioning service. Some help is also to be found in various magazines and trade journals published in Australia, New Zealand and elsewhere, but much more could be done in this line both in magazine and manufacturers' publications.

The British Refrigeration Association and other similar associations deal with the commercial problems of the industry and the Institute of Refrigeration, the American Society of Heating, Refrigeration and Air-conditioning Engineers, the International Institute of Refrigeration and some other technical societies in various countries do meet the needs of the scientist and engineer. However, apart from the two United States Societies named in the previous paragraph, few organizations exist to meet the needs of the serviceman in the field. One such organization in the United Kingdom is the Refrigeration Servicemen's Association, founded about eight years ago in Liverpool and revived in London in 1958. This runs on exactly similar non-political, non-partisan lines to those of the Institute of Refrigeration and its activities are designed to meet the educational, technical and advisory needs of the practical men in the field. Starting from small beginnings, this organization is building up its membership in the London area and hopes soon to start branches elsewhere. A number of servicemen overseas have also joined. The R.S.A. runs a series of monthly lectures and discussions on a wide range of subjects relating to refrigeration and air-conditioning and their applications and it also arranges visits to interesting installations.

It is hoped that more can be done as time goes on, especially to raise the standard of service by improved standards of knowledge. This should also lead to an improvement in the status of the installation and serviceman and hence the standard of the man attracted to the job.

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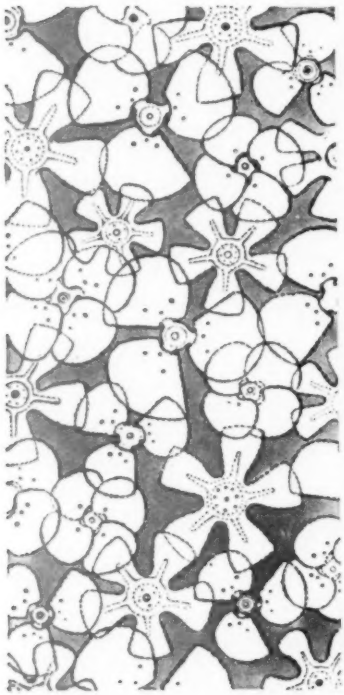

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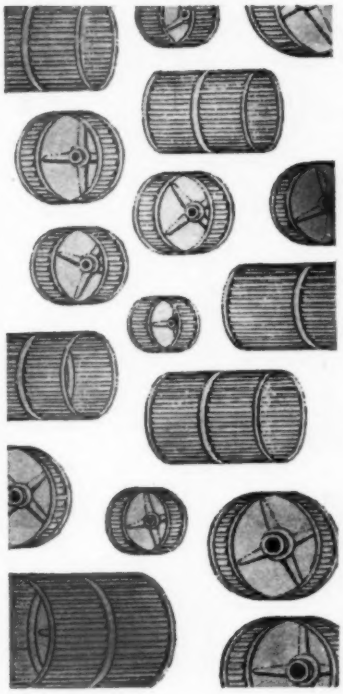

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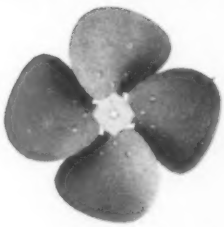

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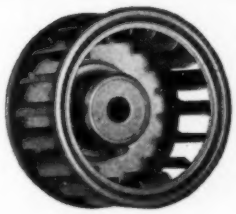

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How Cool to keep in the Tropics*

The Measurement of Climatic Warmth

THERE are four indoor climatic factors producing, or modifying, the sensation of warmth : the temperature, humidity, movement of the air, and the temperature of the surrounding surfaces. Their relative importance varies with the warmth of the climate. Taking temperature as the norm, humidity has a cooling effect at low temperatures, zero effect at moderate temperatures, and a warming effect when the temperature is high. Eventually, when the climate is unendurably warm, humidity becomes the dominant factor. Air movement, again, is powerfully cooling in a cold climate, but its effect is less when the air is less cold. When conditions are warm enough to make people sweat, the cooling effect of air movement suddenly increases again for a time. But when it is really hot, strong air movements have a heating effect. Radiation from heated surfaces is always warming in its effect.

It is convenient to measure the subjective warmth of an equatorial indoor climate in terms of the temperature of still air, saturated with moisture, which is subjectively felt to be equally warm. This definition was first used by Houghton and Yaglou, for their Effective Temperature Scale. The scale itself was faulty owing to the use of first impressions of the climate to determine the equivalences. First impressions are definite and strong, but they are misleading. We will use Houghton and Yaglou's definition, but not their scale.

The Equatorial Comfort Index, a new scale, uses values of the equivalences bases on data of a different kind, obtained partly in homes and offices in Singapore, and partly in the climatic chambers of the Medical Research Council. The Equatorial Comfort Index is embodied in a nomogram.

To use the nomogram, the dry-bulb and wet-bulb temperatures should be marked on the left and right hand scales, and joined by a straight line. The line should then be followed through the network of curves lying between the two temperature scales, until one comes to the curve corresponding to the measured air velocity. The intersection, in relation to the short vertical divisions of the Equatorial Comfort Index scale, shows the value of the index. It can easily be estimated by eye to $^1/_{10}$ ° F.

Although the same definition has been used, the value of the Equatorial Comfort Index is, in general, different from that of the effective temperature. In ordinary indoor climates it is lower, because humidity and air movement receive more allowance in the index scale ; and the index value is much more closely related to the subjective sensation of warmth.

Refrigeration

Refrigeration is too often a prestige matter, whose expense is a source of pride to the user. This is a pity, because refrigeration has valuable positive uses when thorough ventilation is inappropriate, owing to the warmth, or contamination, of the outside air, or to the necessity of excluding noise or draughts. There is a possibility that refrigeration and ventilation could be used together, with considerable economy, in difficult cases ; and refrigeration is always available when all else has failed to correct a faulty building design. In any case refrigeration should always be used with reference to realistic comfort standards, or other climatic requirements.

If the sole task of refrigeration is to remove metabolic heat from a room, so that human occupation is prevented from worsening an already warm indoor climate, then one ton of refrigeration should be sufficient for a score or more of adult people who are lightly active. It is reasonable however to expect something more of refrigeration ; and to use it to attempt to improve the indoor climate, lowering the temperature and the humidity so as to reduce discomfort, or increase work output. The optimum climate for unclothed subjects appears to be in the neighbourhood of 80° F. on the Equatorial Comfort Index ; and for the lightly clothed people of Singapore we have seen that the optimum is 78° F. on the same scale. For U.K. clothing and acclimatisation it is in the vicinity of 68° F. Obviously more comfort data are required for the tropics, but these figures provide the basis for a first sketch of what the optimum might be in a particular case.

Small departures from the optimum are of little concern, as both comfort and output graphs are flat at this point. It is therefore uneconomic to go quite so far as the optimum in designing for air-conditioning. Maximum economy is probably associated with the point of inflexion of the comfort graph, at about 2° F. above the optimum on the Equatorial Comfort Index scale ; and a reasonable design value might lie halfway, at 79°F. Equatorial Comfort Index for Singapore people for instance. An exact choice could in theory be made by balancing the cost of conditioning against the value of increased output, if the data were available and such precision appropriate or necessary.

As an auxiliary to ventilation, it would appear economical to try feeding cooled air into the slipstream of a ceiling fan in Malaya ; or into the high-level air intake of the buildings of the Middle East.

* Excerpts from Building Research Station Note No. E1046, Oct., 1960, " How Cool To Keep In The Tropics and How To Keep Cool, Too " by C. G. Webb, B.SC., F.INST.P. of the Building Research Station. (A lecture to overseas architects and engineers.) Crown Copyright Reserved.

EXTERIOR WALL-MOUNTED HEAT PUMP

THE air-conditioning division of Westinghouse Electric Corporation has recently developed a completely new type heat pump that attaches directly to the outside wall of a house, greatly reducing the time and cost of installation. The outside wall-mounted heat pump—first of its kind—brings a " quiet, practical and economical " form of central air conditioning to mass housing.

The new unit is equally suited to a variety of other applications including offices, mobile homes, motels, apartments, stores, factories and petrol stations. Field tests, in Miami, Tampa, St. Petersburg, New Orleans, Phoenix and Los Angeles have proven the new heat pump's effectiveness.

One contractor placed the cost of the unit plus installation at approximately £175—for a ranch style home of concrete block construction. For this home, the heat pump was mounted on an outer wall adjacent to a clothes closet. Ductwork carries the

cooled (or heated) air to a drop ceiling in the centre hall. (The return duct was located at the bottom of the closet.) The new product offers quiet, high-quality central system cooling, and also provides mild-weather heating.

The heat pump is rated at 18,000 B.t.u. which is equivalent to 1½ tons of cooling capacity. Each unit serves a house with 1,000 square feet of area, but for larger homes, two units may be applied with one supplying the living-dining-kitchen area and the

The new heat pump, developed by the Westinghouse Electric Corporation, is designed for installation directly on the wall of a home or commercial structure. Installation requires the removal from the wall of only two cement blocks similar to the one held here by Joseph Cerny, residential products manager for the company's air-conditioning division.

other the bedroom-bathroom area. The heat pumps may also be used in multi-storied dwellings with one unit serving each floor level. Installation is possible from a balcony, porch or garage roof. One unique method is to mount the heat pump on a hinged panel similar to a door, which is kept closed and locked when the unit is in operation. Opening the door into the room permits installation and maintenance.

Approximately six feet high, two feet wide and one foot deep, the cabinet of the heat pump projects about the same distance from a wall as the overhang of the average roof. Brackets, which are a part of the unit, support it.

For a home of block construction, only two blocks need be removed for installation purposes. Air flows into the home through the upper opening.

The Bulletin of the International Institute of Refrigeration, No. 1, 1961

Reviewed by DR. EZER GRIFFITHS, *Hon. President of the I.I.R.*

THE number of member countries in the Institute is now 42. The associate membership has now risen to 436, the members being drawn from 48 countries.

The *Bulletin* contains the names and addresses of members of commissions from January 1, 1960, and will be valid until December 31, 1963.

The Institute receives orders for abstract publications from 38 countries.

Reviewing some of the abstracts in the present number of the *Bulletin* we note one entitled: "Germanium resistance thermometer, a new miniature thermometer for the measurement of temperatures down to absolute zero." Another abstract on temperature measurement deals with a carbon resistance thermometer capable of 0.1 per cent. accuracy.

From Louvain there is a paper on the production of temperatures of one hundred thousandth of a degree K. Several abstracts are of papers published in the new journal *Cryogenics*.

A publication from the N.B.S., it is designed to fill a need of designers of cryogenic apparatus for data on specific heats and enthalpics of technical solids. It has 170 references.

A number of abstracts relate to thermodynamic properties of materials.

Under the heading "Heat Transmission," we note two abstracts on measuring thermal conductivity by non-steady state methods: an abstract on specific thermoelectric devices to fill some gaps in heat transfer problems; and an abstract on the measurement of heat transmission coefficients of ceiling coils in the cold storage rooms by the freezing method.

There is an abstract of a paper with the title "Refrigerant drying requires considerable time before equilibrium is gained."

A Danish paper gives an experimental comparison of uniflow and counterflow compressors for refrigerant 12, and an Australian paper deals with the economics of booster operation. Another paper from the same country discusses the detection of refrigerant leaks.

There are three abstracts relating to the testing of refrigerated cabinets.

A number of abstracts relate to cold rooms; one describes the evolution of techniques in the field of equipment, another deals with rooms for quick cooling, and another with sliding doors and air screens for cold stores.

In the warehouses section there is a description of a store for cooling and frozen storage, completely automatically supplied with cold brine. Control electric equipment in big refrigerating plants and the thermal dimensioning of continuous pea cooling equipment are of interest to designers.

From Brazil there is a paper entitled "Comfort physiology"; from the Netherlands "Comfort and comfort climates"; and from Spain "Limits of the 'zone of physiological comfort' related to air-conditioning: essential data to be considered for the design of plants in Spain."

Air-conditioning of department-stores, schools, nuclear research equipment, paper and textile industries, and printing works are dealt with in a number of abstracts.

Turning to transport there is a lengthy abstract dealing with improvements in refrigerated transport by rail and another dealing with refrigerating equipment on board ship.

A number of abstracts appear under the heading of "Containers." It is stated that frozen foods keep colder in foil.

Under the gas liquefying industry we note a paper on a Joule Thomson helium liquefier and some problems in its design; another on handling of low temperature fluids and high pressure oxygen; and another on performance of some plain bearing material under boundary conditions at low temperatures.

A number of abstracts deal with frozen food. To mention a few: "Role of psychrophilic bacteria in frozen food spoilage," "Freezing and refrigeration equipment," and "The quality of frozen products."

An abstract entitled "Storage of fruit at temperatures near the ordinary by means of plastic packaging," states that the lowering of oxygen in reducing the respiratory activity is the main factor.

Several abstracts deal with gas storage. Under "Meat" reference is made to a test substance for freezing experiments, its properties manufacture and packing. It is comparable to lean beef in thermal properties.

Another abstract under Meat is "Quick-cooling and superficial contamination." Also there is one entitled "Estimated costs of retailing frozen meats as compared to fresh meats."

Several abstracts relate to milk cooling, one of which is entitled "Practice with the milk collecting express."

Under "Fish" we note abstracts on "Dielectric method for thawing fish developed," and "Assessment of the progressive spoilage of ice-stored shrimps."

Beverages are topics of several abstracts: "The cooling of fermenting grape musts," Modern cooling equipment for breweries and malting plants," Consumer opinion of sweeteners in frozen concentrated lemonade and orange juice drink." One abstract gives a lengthy account of fruit cooling plants in Mediterranean countries, another what institutional managers think about freezers and frozen foods.

Mention is made of two standards issued by the U.S.A. One deals with ammonia compressors and the other with compressors for refrigerant 12 and refrigerant 22.

The *Bulletin* contains the full text of a paper entitled "Controlled temperature transport of perishable foodstuffs in aircraft." It takes up 23 pages.

Some of the topics of various publications received at the library are: "Recommended conditions for cold storage of perishable foodstuffs" (German translation); "Marketing and consumption of frozen fish"; "Higher agricultural training"; "Preservation of life by means of refrigeration"; "Radiation technology in food, agriculture and biology"; "The industrial cooling tower"; and "The 5th symposium on foreign materials in foodstuffs."

A NEW LUXURY AIR-CONDITIONER FROM TEMPAIR

The board-level "Director," a new luxury air conditioner, has just been announced by Rootes Tempair, of Maidstone. The company claims that extensive testing and developing has made this new model, one of three which Tempair is now adding to its range, the quietest air-conditioner in its class. Designed to air-condition boardrooms, the "Director" is finished in beige, old oak and silver and blends easily with traditional and modern decor. The "Director" combines exceptional airflow with a unique method of air distribution. It gives coolness in summer, clean filtered air at all times and there is also a thermostatically controlled heater available as an extra. The "Director" is also suited for use in hotel suites, salons, reception, conference and waiting rooms.

Measuring less than 3 ft. high and 3 ft. wide, installation requires neither wall nor window breaching. The "Director" is available either water cooled or air cooled and has a moisture removal capacity of five pints an hour. Its evaporator airflow works at the rate of 420 c.f.m. and its heating unit has a capacity of 3 kW. The price of the water cooled unit is £210 and the air cooled unit costs £265.

To The Editor,
Modern Refrigeration and Air Control,
London, S.E.1.

Sir,

I was interested to read in your April issue the description of the dual-temperature cabinet being produced by Metcold Products; but I am puzzled by the statement that ice cream losses occur when holdover plates are used.

Over the years my company has made and supplied—and continues to do so—large quantities of holdover plates and liners and I can recall no instance of any complaint about ice cream losses due to too much or too little holdover.

Nor do I understand why it should be claimed that in a transport application, such as this, an over-the-road direct expansion system results in less temperature fluctuation than does a system relying entirely on holdover.

If you could publish some more detailed information on these questions it would, I am sure, be of interest.

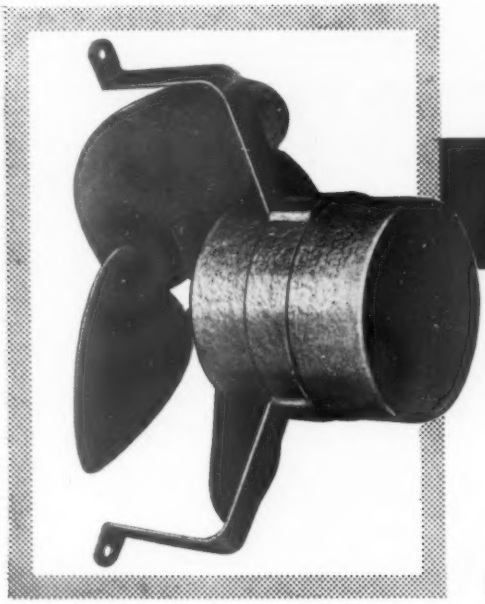
Yours, etc.,

L. O. Lawrence,
Sales Manager,
Winget Refrigeration Limited.

April 26th, 1961.

NEW BATTERSEA CHAMBERS—(*continued from p.* 502)

The refrigeration plant is by L. Sterne & Co. Ltd. A new engine room has been built on the roof of the main building to house not only the plant for the new extension, but for all the stores, the overall capacity of which is now in the region of 200,000 c.ft. The contractors for the building and insulation were T. W. Weeks & Co., Battersea. As it now stands, the plant comprises: three 3-MAC compressors by L. Sterne & Co. Ltd., shell and tube condensers, receivers and switchgear.



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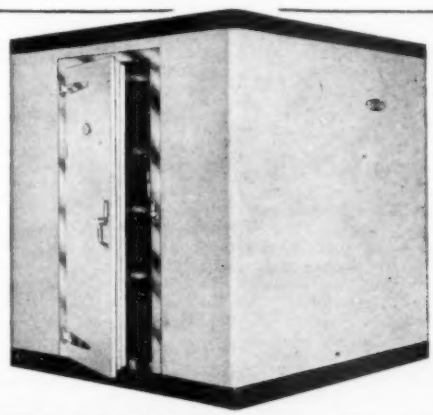

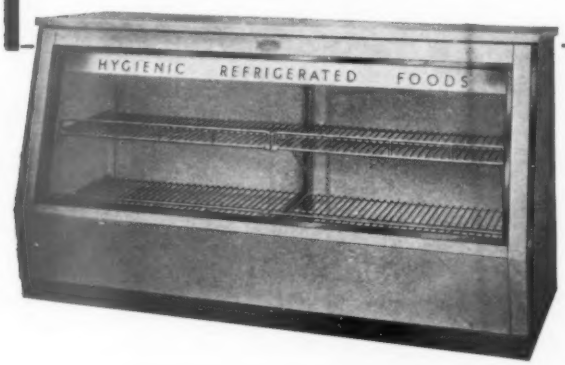

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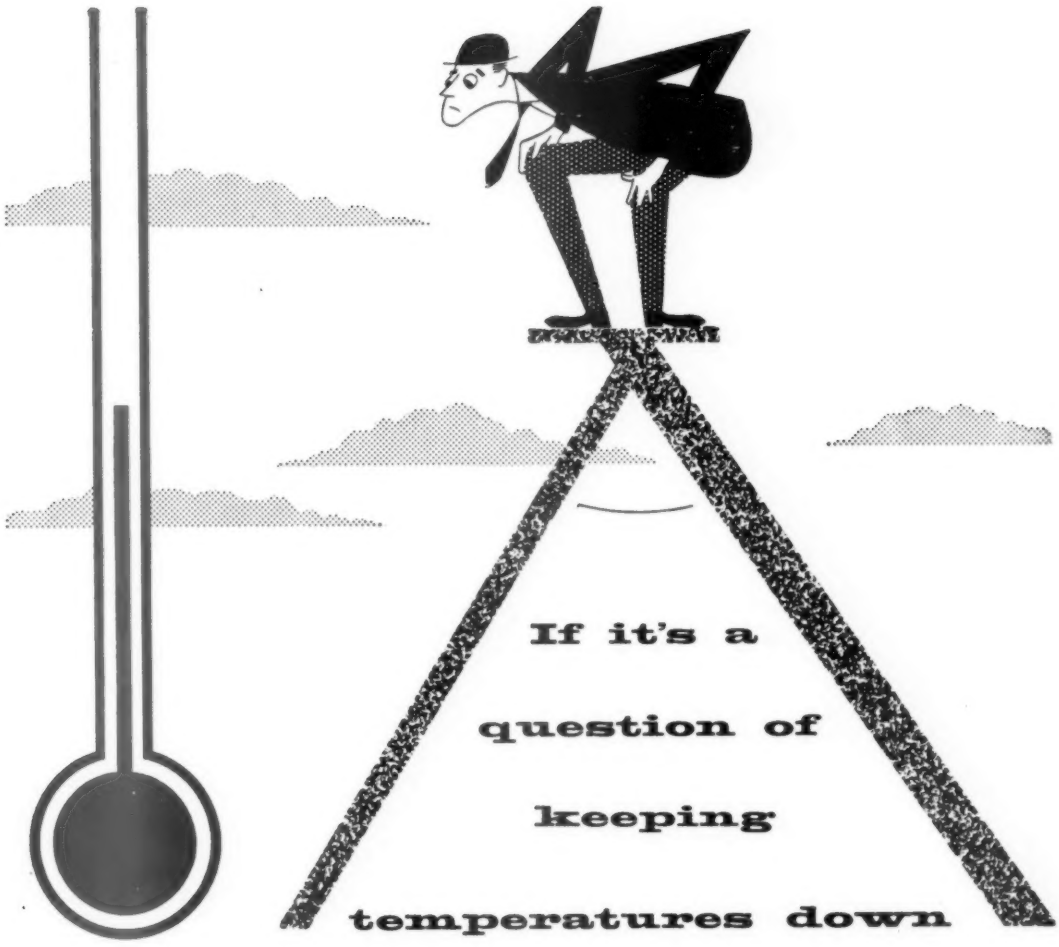

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